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XXXVIII—VARIABILITY IN STOCK-POISON PLANTS. F. N. HOWES.

In recent years there has been a gradual but steady increase in various parts of the world in the interest taken in plants poisonous or injurious to live-stock. This may be attributed to a number of causes. In most of the important ranching and stock-raising regions the number of animals grazed per unit area is now considerably in excess of that which was customary a few decades past. This is so much so in some areas that the grazing is admittedly continuously overstocked. Such overstocking does much to increase the incidence of plant-poisoning, for animals are then prone to consume unwholesome or harmful plants which, under more normal conditions, they would not touch. Furthermore, overstocking frequently results in the course of time in a steady diminution in some, if not all, of the more desirable species, while less palatable plants, some of which may be toxic if consumed in sufficient quantity, gradually increase. Another factor that has contributed to the interest in stock-poison plants is that the number of well bred and valuable stock has increased substantially in most areas and many farms and ranches that formerly carried only inferior or low grade stock now have at least a nucleus of more highly priced stud animals. Naturally with improved stock of this sort the possibility of vegetable poisoning assumes a more serious aspect and deaths resulting therefrom involve greater financial loss. It frequently happens also that the more valuable stock, particularly animals imported from other areas, are more prone to fall victims to plant poisoning than are the locally bred animals or native stock. It has been demonstrated experimentally²⁴ that low grade native stock require considerably larger quantities of certain poisonous plants to produce fatal results than do well bred animals. In addition, imported animals are often less discriminating than those locally bred and may consume harmful plants that are left untouched by other animals. Factors such as these have naturally led to an active spirit of enquiry among state departments and stock-owners regarding the nature of the plants that lead to loss and the conditions that predispose to it.

Losses due to plant-poisoning appear to be greatest in the more arid subtropical parts of the world. In such areas, for example parts of South Africa, Australia, and the South Western United

States of America, the aggregate mortality is without question higher and of greater seriousness than in pastoral regions in temperate countries. In some areas of the United States the annual losses due to poisonous plants are regarded as being considerably in excess of those caused by infectious diseases or predatory animals. There it has been estimated ^{19, 21} that the average loss must be as high as 3-4 per cent. while losses among individual herds may be as high as 50-60 per cent. due to "death camas" (*Zygadenus* spp.) or others of the more dangerous species.

It is in these arid or semi-arid areas, where the vegetation is subject to unusually varied climatic and edaphic conditions, with irregular rainfall and often prolonged conditions of drought, that the question of variability in toxicity among poisonous plants (i.e., variability in the same species) is becoming so apparent. Generally speaking, stock-raising is not of great significance in tropical countries with the exception perhaps of India. The fact that there does not appear to be much vegetable poisoning in India—apart from *Sorghum* poisoning and criminal or intentional poisoning by plant agency which it is not proposed to consider—may possibly be due to the breeds employed being for the most part indigenous to the country and not of exotic origin as in most other cattle-raising countries.

Intensive experimental work has been, and is being, carried out on stock-poisoning plants in various countries, especially South Africa, Australia and several parts of the United States. In many instances the problems confronted are of an involved and complex nature. Diagnosis in vegetable poisoning is often complicated by the fact that the symptoms produced by some plants are closely similar to those caused by certain bacterial diseases or other pathological disorders. It is believed by veterinarians and others that many of the obscure affections of live-stock that at present baffle solution will eventually be traced to plant agency. Some species of poisonous plants affect the animal in a distinctive and characteristic manner, the effects being quite unlike those produced by other poisonous plants. On the other hand different species occurring in different countries may cause a strangely similar type of poisoning. This is becoming increasingly noticeable among plants whose toxicity is of the cumulative type, i.e., where poisoning does not take place until a fairly large quantity of the plant has been consumed continuously over a lengthy period which may extend to several weeks or months. Very definite advances have been made in our knowledge of plants responsible for hydrocyanic acid poisoning, particularly with regard to the role played by enzymes. This has been due largely to the work of Dr. Seddon, Director of Veterinary Research in New South Wales, and his colleagues. In the discussion that follows this work has been freely utilized, as has also the excellent work done in the veterinary field in South Africa and many experiment stations in the United States and elsewhere.

Among the several factors liable to influence the toxicity of poisonous plants two of the most important have been shown to be the season of the year when consumed and the area where grown. Seasonal variation in toxicity has now been closely studied in a number of troublesome plants and some interesting facts ascertained. Many of the most serious stock-poison plants of Southern Africa have been proved to be largely seasonal in toxicity. For instance, *Tribulus terrestris* L. the cause of "geeldikkop," a serious malady with sheep, is only toxic during some two to three months of the year.²⁷ *Pachystigma pygmaea* (Schltr.) Robyns, a plant common in some areas in South Africa, is also responsible for a sheep disease ("goussiekte") and is known to vary a great deal in toxicity from season to season. In some seasons the disease is quite absent whereas in others mortality is high. It has been asserted by farmers in affected districts that the plant is poisonous when growing on red soil but innocuous on black, but investigation has not served to substantiate this belief.³⁷ Another sheep disease, "vermeer-siekte," which is prevalent in some of the drier areas of South Africa, has been shown to be due to grazing on certain species of *Geigeria* among which are *G. passerinoides* Harv., *G. aspera* Harv., and *G. Zeyheri* Harv. These shrubs have to be consumed for several weeks before symptoms develop. It has been shown that they vary considerably in toxicity throughout the year. *Geigeria Zeyheri* for example is very toxic during midsummer (December-January),⁷ but during the long period of February to September is innocuous, toxicity appearing again in about October. Certain species of *Cucumis*, e.g. *C. myriocarpus* Naud. and *C. africanus* L.f. have been found to be troublesome with sheep in the winter months but not in the summer in South Africa.

It has been found that in regions subject to a distinct or pronounced dry season that the incidence of plant-poisoning is often highest at that period when the dry season finishes and the first rains commence. This may be due simply to the fact that at this particular period there is a shortage of pasturage and harmful plants not normally eaten are consumed. In these regions it is often found that in seasons when the rains are late mortality is noticeably higher than in normal seasons. A factor which may, and often does, account for this is that the poisonous plants in question may be of a succulent or bulbous nature and not so dependent on the rains for the commencement of growth as are the grasses or other pasturage plants. The result is that the noxious species appear in leaf first and may be eaten in quantity by browsing animals, particularly as herbage is scarce at that period. Many of the poisonous plants in Southern Africa with bulbous or fleshy rootstocks are of this type, examples of which are species of *Urginea*, *Homeria* and *Moraea*. Such plants are not necessarily seasonal in toxicity, although poisoning from them is seasonal, for they are either dormant or insufficiently attractive to stock for a considerable portion of the year.

Among plants injurious to live-stock in the United States the evil effects of many are closely associated with the season of the year when grazed. Lupin poisoning for instance is associated with the autumn whereas "larkspur" (*Delphinium* spp.) and "death camas" (*Zygadenus* spp.) poisoning occurs mainly in the spring.

The stage of growth when consumed is an important factor with some species in determining whether they are likely to be toxic to animals. Some plants have been shown to be harmful only in the very young stage, others only when flowering or in fruit and others only when in a wilted condition. Plants poisonous only when wilted or in the young stage frequently owe their toxicity to the presence of cyanogenetic glucosides. Some plants, however, which are poisonous only when very young are not cyanogenetic. An interesting example is that afforded by certain species of *Xanthium*. For many years there were persistent reports in America that young cocklebur plants were the cause of death in young pigs. It was generally believed that cockleburs were harmful only in the injurious mechanical effect exerted by the fruits. Experiment subsequently proved, however, that these plants were poisonous in the germinating stage or during the development of the cotyledons. All classes of stock may be affected though a certain quantity has to be consumed for ill effects to occur. After the seedlings attain to a certain size they cease to be poisonous.¹³ *Chenopodium atriplicinum* F. Muell. affords another instance of toxicity in the young stages only. This salt-bush is a common herbage plant in parts of Australia and is frequently grazed by sheep with no ill effects. In some seasons, however, it has been strongly suspected as the cause of heavy mortality. Work in Australia has now shown³⁰ that when fairly large quantities are consumed the plant is liable to prove fatal, though only when the plant is in the young stage. *Echinopogon ovatus* Beauv. the "Noogoora Burr" is another Australian plant regarded as poisonous only in the young (two leaf) stage.

There appears to have been a marked divergence of opinion regarding the danger to live-stock of *Lotus australis* Andr., a plant widely distributed in Australia. Von Mueller regarded it as a deadly poison and stated "sheep are frequently killed in half an hour by it" whereas Maiden considered it a useful fodder and attributed deaths of cattle to their "feeding too greedily upon it." From material examined at the Imperial Institute³⁸ it was found that immature plants contained a cyanogenetic glucoside but fully developed plants contained nothing of a toxic character. This fact no doubt explains the contradictory reports that exist regarding the plant. Another species of *Lotus* that is known to be poisonous in the young stages but not when it has matured and seeds have formed—in which state it is reputed to be an excellent fodder—is *Lotus arabicus* L. This species is indigenous to Egypt and was the cause of heavy losses among military transport animals during the first Soudanese war.³⁸

Dichapetalum cymosum (Hook.) Engl., the "giftblaar," is a fruitful source of poisoning in South Africa. Poisoning occurs chiefly during the period when young growth is made in the spring and autumn. The young growth is considerably more toxic than the old and as little as $\frac{3}{4}$ oz. of the leaves have been proved to be sufficient to cause the death of a sheep.³⁵ It is unusual among stock-poison plants for such small quantities to constitute a lethal dose. With the bulk of the important stock-poisoning plants of the world, i.e., those that actually cause heavy losses, comparatively large quantities have to be taken by an animal before harmful or fatal results occur. This is contrary to popular belief.

There is increasing evidence to show that plants which are toxic in one area may, although plentiful, be innocuous or but slightly toxic in another. The importance of *Tribulus terrestris* L. as the cause of a sheep disease in South Africa has already been referred to. This species is of wide distribution throughout the warmer regions of the world and as a weed is often a serious menace, yet it does not appear to be associated with stock-poisoning in any country except South Africa. There is ample testimony to the effect that the plant is eaten by domestic animals elsewhere. Among Australian plants there are several examples of this variation in toxicity attributed to locality. *Euphorbia Drummondii* Boiss., a common weed in many parts of New South Wales and constituting a considerable part of the herbage in some instances, has been found to be toxic in some localities but not in others.²⁹

Diseases of sheep in Australia known commonly as "staggers" or "shivers" in which the animals develop a staggering or trembling condition on being exercised, often resulting in death, are caused by certain alien species that have become completely naturalized, viz:—*Stachys arvensis* L., *Malva parviflora* L., and *Lamium amplexicaule* L.²⁸ It is interesting to observe that these plants are natives of European countries but do not appear to have come under suspicion in regard to poisoning in their native habitat. There are also good reasons for suspecting that *Lantana crocea* Jacq. and *L. Camara* L. may vary in their degree of harmfulness to stock in different parts of Australia.

In India *Lathyrus sativus* L., a commonly cultivated pulse and food-plant of both man and beast, is well known to be the cause, after continued feeding, of a cerebro-spinal disease resulting in paralysis and known as "lathyrism." The seeds sometimes contaminate cereals or other pulses and have been suspected of injurious effects on animals in European countries fed with grain imported from India. It is reported that in 1891 Russian peasants of Saratov suffered from "lathyrism" as a result of large quantities of this pulse being imported and used in the preparation of bread owing to the shortage of wheat at that time. It is of interest in this connection that in Canada, where *Lathyrus sativus* is cultivated and the seeds used as food, toxic symptoms do not arise.³⁸

The grass *Stipa Vaseyi* Scibn., known as "sleepy grass" in New Mexico, is of fairly wide distribution in the south western United States. In most areas the grass may be eaten without any ill effect but in some a peculiar narcotic effect on horses is produced, hence the name "sleepy grass." From feeding tests with horses it was shown that while profound slumber was produced it did not cause death. It is only in two particular areas that this peculiar effect is associated with the plant in spite of its comparatively wide range.²³ The well known succulent *Cotyledon orbiculata* L. or "pigs ear" is known to be frequently the cause of paralysis and sometimes death in fowls in South Africa and also death in sheep. It has been found that the toxicity of the plant varies in different areas and this variation is believed to be due to soil conditions.³⁶

In poisonous plants the active principle generally exists in greater concentration in some particular organ though there are instances where a more or less even concentration exists throughout the whole plant. Of the large number of species with the active principle confined to, or located chiefly in the roots or rootstock, few are of any consequence to live-stock owing to the general inaccessibility of these organs. There are, however, occasions where stock are able to procure and devour the underground parts of such plants. It frequently happens that after storms or heavy rain, when the ground is soft, roots come away with the aerial parts on the first tug of the grazing animal and are consumed. The nature and texture of the soil and the toughness of the aerial parts are naturally factors in determining whether this will occur. Monocotyledonous plants, with a bulbous or fleshy rootstock are liable to behave in this way, and it is believed by some observers in the United States that the "death camas" (*Zygadenus* spp.) are often responsible for increased poisoning after rains in this manner. Another effect of heavy or torrential rain is that rootstocks along streams and watercourses are liable to be washed up or exposed. This is believed to be a common source of poisoning with species of *Cicuta*, particularly *Cicuta occidentalis*, the "poison parsnip" or "water hemlock," common in parts of the United States. It has been shown that the old rootstocks of this species are exceedingly poisonous throughout the year, though the young roots contain little or none of the poisonous principle (cicutoxin) which exudes from the cut root as a reddish or yellow liquid. The roots of this species appear to vary somewhat in toxicity according to locality, some from Nebraska having been found to be rather less poisonous than those from Nevada.¹² Leaves and stems of this plant were found to be poisonous when very young in the early spring but to be harmless in the later stages of growth in the summer and autumn. It is possible that some of these facts may hold for species of *Cicuta* harmful to stock in other countries.

Apart from the role played by the plant in cases of poisoning, the species or breed of animal and its age and condition at the time of

ingestion are important factors in determining the effect produced on the animal, particularly where poisoning is due to prussic acid. Generally speaking young and immature animals are far more susceptible than the older ones.

The feeding habits peculiar to the species are sometimes responsible for one class of animal being entirely unaffected in a grazing area that may be dangerous to others. Thus sheep are more selective feeders than cattle or horses and often leave plants that are eaten indiscriminately with the other herbage by larger animals. For instance, species of *Ranunculus* when in flower—the flower being the most poisonous part—may poison cattle and horses but not sheep who are better able to avoid them. Sheep are notoriously erratic in their feeding habits and have been recorded as avoiding a plant one day which they may partake of copiously the next. Furthermore some sheep may be observed feeding freely on one species that other sheep in the same flock will avoid entirely. The individuality of stock in this respect has been well illustrated in the feeding tests that have been conducted in poison plant work. In work on *Matricaria nigellaefolia* DC., the cause of “push-sickness” or “staggers” in bovines in South Africa it was found that some sheep would eat the plant with avidity while others regarded it with absolute repugnance. With the latter ingestion could only be achieved by drenching.¹

There may be great variation even among similar animals in their resistance to the effects of injurious plants. Among animals of the same breed, age, and state of health, etc., it has been found that the quantity of a given plant required to kill one animal may be four times as great as that required as a lethal dose for another. This has been found to be very noticeable in those plants with the cumulative type of toxicity. It is common knowledge that one species may be harmful or fatal to one class of animal but harmless to another. Other species may be harmful to more than one class of animal but produce different symptoms in those respective classes. The action of *Leucaena glauca* Bth. on domestic animals in the tropics affords an interesting example of a plant harmful though not fatal to some classes of animal but harmless to others.

This plant, known commonly as “wild tamarind,” “jumbie” or “ipil-ipil,” is a native of the American tropics but is now widely distributed in tropical and subtropical countries, being used in some regions as a soiling crop, fodder or hedge plant. In some countries, notably Fiji, it has spread to such an extent as to be regarded as a troublesome weed. The leaves and young shoots are readily eaten by most grazing animals and the plant affords nutritious hay.³⁹ It has been observed in the West Indies, Philippines⁴⁰ and elsewhere that horses feeding on the plant to any extent completely lose the hair from their manes and tails. The same is said to apply to mules and donkeys and in the case of pigs all the hair may fall from the body leaving them completely naked.²⁵ Apart from the loss of hair these animals are said to be unaffected in any other way and if

transferred to grazing grounds where the plant does not occur the hair soon grows again. In the case of horses the new growth of hair of the mane and tail is reputed to be of coarser texture and different colour in some cases. Cattle, sheep and goats are able to consume the plant in quantity without perceptible effects and this depilatory action does not occur. In short the animals affected are non-ruminants whereas those unaffected are ruminants. It has been suggested that in ruminants the process of mixing the food with saliva and slowly digesting it may cause the poisonous principle to be neutralized and these animals therefore escape injury.

The "crinkly leaf poison," *Gastrolobium villosum* Bth., of Western Australia, is reputed to be poisonous at all periods of growth to horses, donkeys and ruminants, but to be eaten without ill-effects by wallabies.¹⁷ Numerous other similar instances of immunity in wild animals are known.

The curious effect of certain plants in acting harmfully only on animals with unpigmented skin or those breeds without pigmentation is well-known in such plants as *Hypericum perforatum* L., St. John's Wort; *Fagopyrum sagittatum* Gilib., Buckwheat; *Medicago denticulata* Willd., Trefoil Burr; and certain species of *Trifolium*. The ingestion of such plants by stock in sufficient quantity leads to photosensitization with the development of dermatitis and later necrosis of the unpigmented surfaces of the body on exposure to sunlight. Those animals in which the exposed parts are pigmented are quite unaffected. Sunshine is necessary for the development of the malady and if dull weather accompanies or follows feeding of the plant, or if animals are kept out of sunshine, symptoms do not appear. Owing to the prevalence of St. John's Wort in parts of Australia and the trouble that is experienced with photosensitization in sheep due to it, considerable attention has been directed to the plant and to possible means of control. It was thought at one time that possibly only the mature plant was harmful but it has now been shown³⁴ that the plant may cause photosensitization even in the early stages of growth. This fact has removed the possibility of curtailing growth and development of the plant in its early stages by enforced grazing with sheep. Buckwheat has been known to cause photosensitization resulting in injury and loss in various classes of live-stock in the United States.¹⁹ It is probably not generally known that this extensively cultivated grain-crop and fodder is capable of serious poisoning under certain conditions. The plant is said to be most toxic when in flower. Among animals liable to be affected the more buckwheat consumed and the hotter the sun the greater will be the reaction. The head and ears are the parts most commonly affected. In extreme cases it is stated that digestive disturbance and brain affection may occur.

Before photosensitization can occur three conditions are necessary:—(i) the animal must possess an unpigmented or partly unpigmented skin, (ii) there must be sufficient intensity of sunlight,

and (iii) a sufficient quantity of the plant in question must have been consumed.

Poisoning from the presence of compounds of hydrocyanic acid in plant tissue is of common occurrence and no doubt occurs more frequently in the *Gramineae* than in any other family. Species of *Sorghum* have been long known to be liable to contain dangerous amounts of such glucosides and to have been the cause of serious fatality among various classes of stock. It has been found in *Sorghum* and many other plants that danger exists chiefly in the early stages of growth, i.e., during the period of rapid formation of new tissue, or when the plants are in a wilted or damaged condition.

With most cyanogenetic plants a fairly large quantity of material must be consumed by the animal within a comparatively short time for death to occur. Death is then rapid, occurring within a few hours and in some instances within a very short space of time. When the material is ingested in small quantity only, the poison is rapidly eliminated by the system of the animal. Thus in the course of a day's grazing an animal may consume, in relatively small quantities and at intervals, material of a cyanogenetic plant, which, if taken at one feed, would be far more than sufficient to cause death. Many pasture and browse plants, regarded as excellent stock-feed when consumed under normal grazing conditions, i.e., eaten at intervals and grazed along with other plants, may cause death if eaten extensively in a short period of time. *Prunus demissa* A. Diet., the "western chokecherry," which is common in the mountain grazing areas of Nevada and elsewhere in the United States, is a plant of this class. In regions where the plant occurs poisoning in sheep is frequently found to occur soon after drinking from the mountain streams and has been attributed by shepherds to the water in the streams. Investigation, however, showed that such animals had previously eaten fatal doses of "chokecherry" but that the moisture in the stomach had been insufficient to liberate the poison until the animals drank from the stream. Poisoning from this plant is believed to be due primarily to dried and overgrazed conditions of feeding areas. It is stated that in late summer the plant loses its poisonous properties and may be consumed in quantity by sheep in the autumn without ill-effects.¹¹

The question of the occurrence of compounds of hydrocyanic acid in ordinary pasture grasses has received close attention in recent years, especially in South Africa, where it has been suspected that the sudden unexpected deaths among stock on grass-veld that sometimes occur may be attributed to this cause. There it has been shown that some of the veld grasses never contain hydrocyanic acid, others develop it in small quantities only under special conditions or in certain stages of growth. Among several Bechuanaland grasses tested by Henrici¹⁶ only one species, *Chloris petraea* Sw., was found to show any trace of a cyanogenetic substance in the fresh unwilted state. The same worker found that those veld grasses that develop

a purplish red colouration during drought periods, characteristic of many South African grasses, contain little or no cyanogenetic compound, whereas those species with cyanogenetic substances never showed anthocyanin. The period when cyanogenetic compounds were most freely developed was before the rains in spring, or after the spring rains if wilting conditions should occur, and not during the summer drought periods as might be expected. Different species were found to vary considerably in regard to the stage of wilting at which the development of cyanogenetic substances occurred. These substances were found to disappear rapidly—within a few hours—after the recovery of the grass from the wilted to the normal state as the result of rain.

It is known that certain leguminous plants, normally nutritious fodder plants, may sometimes show evidence of hydrocyanic acid and that this is liable to considerable variation. Among these is the European species *Lotus corniculatus* L. Specimens from the same area have been shown to be completely devoid of any cyanogenetic substance in one year but to possess a considerable quantity the next.² Furthermore stunted drought forms exhibited a more abundant development of the substance than did forms of more luxuriant growth.

Many fodder plants which may be cyanogenetic, such as "Johnson grass," *Sorghum halepense* Pers., and other species of *Sorghum*, are commonly regarded as quite innocuous when dried or made into hay, the cyanogenetic substance present being often of an unstable nature and free hydrocyanic acid rapidly disappearing on drying. It has now been shown by Seddon and others³³ that the cyanogenetic glucosides causing prussic acid poisoning vary considerably in stability. In some plants they may be quite stable, in others relatively unstable. In the case of stable glucosides the presence of the requisite enzyme is necessary for the splitting of the glucoside before liberation of hydrocyanic acid is possible. With animals fed exclusively on a dried cyanogenetic plant the necessary enzyme may not be present, or present in insufficient quantity, to cause poisoning. However, it is now believed that very frequently the necessary enzyme may already exist in sufficient quantity in the rumen of the animal as a result of previous feeding on fresh plants that contain it. If other plants containing the necessary enzyme be ingested together with, or soon after, the cyanogenetic plant the necessary enzyme is supplied and poisoning may occur.

Variation in cyanogenesis has now been shown to be a feature of many Australian plants dangerous to live-stock.⁹ One of the best examples is probably that afforded by *Euphorbia Drummondii* Boiss. This plant, a common weed in some parts of Australia, has long been suspected among some stock-owners as the cause of death in stock whereas others have always contended that the plant is harmless. Systematic collection and examination of material of the plant has now shown why such diversity of opinion regarding its

toxicity should exist. Out of a total of one hundred and thirteen specimens examined from various localities in New South Wales only eleven were found to contain a cyanogenetic substance.⁹ Among these it was found that in some the glucoside was accompanied by sufficient enzyme to cause total hydrolysis, while others—procured later in the season—were found to be deficient in enzyme and could only develop their total amount of hydrocyanic acid when additional enzyme from an outside source had been added. Certain species of *Acacia* occurring in Australia are also known to be cyanogenetic but to be devoid or nearly devoid of the requisite enzyme for liberation of prussic acid. Among other dangerous cyanogenetic plants of Australia are *Cynodon incompletus* Nees, “blue couch”; *Heterodendrum oleifolium* Desf. “rosewood”; *Lotus australis* Andr. “birdsfoot trefoil”; *Silybum Marianum* Gaertn. “variegated thistle” (possibly); and *Chenopodium carinatum* R. Br.²⁹ The last mentioned has been found to be cyanogenetic in some localities in New South Wales but not in others.³¹

In an investigation carried out on the amount of hydrocyanic acid in *Sorghum* spp., Sudan Grass, *Sorghum sudanense* Stapf, and various *Sorghum*—Sudan Grass hybrids¹⁰ it was found that a very wide range in the amount of hydrocyanic acid among different varieties and hybrids occurred. All were found to contain a certain amount up to a hundred and thirty days from sowing, the actual amount varying from 2–331 millegrams hydrocyanic acid per 100 grams of the fresh plant.

The importance of saponins in plants as the cause of several obscure stock diseases in many parts of the world is now well recognised. In the majority of cases it is only by the prolonged ingestion of these saponin containing plants that the injurious results are caused. It has been shown⁸ that the presence of certain other substances in the plant, such as tannin, may completely counteract any ill effects from the saponin, even though the saponin may be present in quite considerable quantity. The following species are listed by Ewart⁸ as being among those plants known to cause specific diseases of livestock owing to the presence of saponins:—*Atalaya hemiglauca* F. Muell.; causes “walkabout” disease of horses in parts of Australia; *Solidago rigida* L.; affects horses in North America; *Solidago canadensis* L.; affects livestock generally in North America; *Aster Parryi* A. Gray; causes “grub in the head” disease of sheep in N. America; *Senecio Jacobaea* L.; causes “Winton” disease of horses and sheep in New Zealand; *Senecio latifolius* DC.; causes “Molteno” disease of horses and cattle in South Africa; *Senecio* sp. ?; causes “dunsiekte” disease of horses in South Africa.

Ewart states, “Little attention has been paid to the effect of the prolonged ingestion of plants containing saponin upon grazing stock, but it is quite possible that certain obscure diseases of stock, and more particularly of horses, in various parts of the world may be due to this cause.”

Saponins are known to occur freely among flowering plants and to be very prevalent in some families. The amount varies considerably among different plants and in the different organs of the same plant, and may vary in the same plant according to season and stage of growth. Usually seeds and fruits contain most saponin when mature. The percentage in the leaves also usually increases as the leaves mature but decreases on further ageing. In some plants saponin is located chiefly in the root and in others in the bark. Under such circumstances it is hardly likely to be of concern to grazing animals. In a normal healthy animal the amount of saponin absorbed through the alimentary canal when the animal first has access to a harmful saponin-containing plant is small. Continued ingestion, however, is stated to lead to inflammation of the alimentary canal resulting in an increase in the amount of saponin absorbed from subsequent feeding.

In Australia "walkabout" disease of horses, due to the "white-wood," *Atalaya hemiglauca* F. Muell., is stated to occur only north of the nineteenth parallel whereas the tree occurs abundantly down to the twenty-fifth parallel.⁸ In experiments made with the material from the more northerly areas and from the southern areas of distribution it has been found that the former owes its toxicity to the presence of a considerably greater quantity of saponin. From tests conducted on snails it would appear that the saponin of plants from the more northerly areas is of a more toxic type. The suggestion has been made that "the plant may contain two or more saponins of varying toxicity in variable proportions."⁸ Furthermore, it has been found that plants from areas where the disease does not occur have shown evidence of a higher tannin content. As tannin is known to counteract the effects of saponin in some instances it is possible this variable tannin content may also be a factor in determining the presence or absence of "walkabout" disease. It has been found that even in northerly localities the degree of toxicity of the plant may vary somewhat from one area to another. With regard to the absence of "walkabout" disease from the southern areas of distribution of *Atalaya hemiglauca*, Ewart states:—"Many other cases are known in which a poisonous plant becomes harmless near its southern or northern temperature limit owing to its developing little or none of its poisonous principle under less favourable temperature conditions, and this effect will be increased if the plant under these conditions produces more of a protective substance such as tannin, or forms a variety of the poisonous principle which is more readily decomposed in the alimentary canal."

"Winton" disease of horses and sheep in New Zealand has been produced artificially by feeding ragwort, *Senecio Jacobaea* L., over a prolonged period, the plant having been shown to contain 4-5 per cent. of a water soluble haemolytic saponin. Other species of *Senecio* are associated with stock diseases in other parts of the world, e.g., "Moltano" disease of horses and cattle in parts of South Africa

and "Pictou" disease of Nova Scotia. In some instances poisonous principles other than saponin have been isolated and regarded as playing a part in poisoning. It is considered that they may act also as intestinal irritants increasing the permeability of the alimentary canal and raising the effective toxicity of the plant when eaten.⁸

There are many instances where it is known that deficiencies in the soil of certain minerals results in similar deficiencies in the plants growing in these soils and that these in turn may be responsible for maladies in grazing stock, such maladies being commonly known as "deficiency diseases." It is therefore possible that a plant or community of plants may afford a wholesome and adequately balanced stock-food in one area while in another it may, in the course of time, be responsible for a deficiency disease owing to the shortage of a certain mineral under altered soil conditions. Such plants are therefore to be judged as wholesome or unwholesome animal foods according to their chemical composition in any one habitat and it is the soil conditions, in being responsible for the variation in composition of the plant tissue, that ultimately govern the presence or absence of these deficiency diseases. These plants are harmful owing to the absence of a constituent necessary for the health of the animal, rather than to the presence of any toxic substance as is usually the case with plants harmful to stock. The lack in the pasturage of any one of the essential minerals may cause only a mild disorder in the animal such as unthriftiness or lack of condition if of mild degree, but if of greater intensity it may lead to more grave disorders and to the death of the animal.

In addition to mineral deficiencies the lack of certain organic constituents, e.g., vitamins and amino-acids, are known to cause nutritional disturbances.³² Under natural grazing conditions with live-stock, however, it is the mineral deficiencies that are responsible for the more serious types of deficiency disease throughout the world. The insufficiency of such minerals as phosphorus, calcium, iron, and iodine in animal nutrition has been closely studied and their absence in requisite quantity in pasturage has been shown to cause some of the worst forms of deficiency disease in different areas.²⁶ As a result of these studies interesting observations have been recorded regarding the role played by the plant and the extent to which the same species may vary in certain mineral content under different conditions of soil, climate, or season.

Phosphorus deficiency in the pasturage is particularly acute in parts of Australia and southern Africa. In South Africa this deficiency is especially widespread and has been proved to be responsible for much of the unthriftiness of stock and for some of the worst maladies of live-stock—notably "lamsiekte" and "stijfsiekte"—which cause heavy mortality. The analyses of some of the commoner veld grasses in South Africa have shown that in many instances they contain only about one-sixth the amount of phosphorus that is usually contained in common European grasses. It

has been demonstrated by Henrici¹⁵ that there is remarkable variation in phosphorus content according to season. It is highest with the advent of the spring rains while the grasses are in early stages of growth. The phosphorus content remains at this relatively high level only for a short period in most areas, whereupon it decreases and reaches its lowest level at the end of the summer. In one area the percentage of phosphoric oxide was found to be as low as .04 at this period, as against .65 for the high early spring figure in the same area. The same worker has demonstrated that periods of drought, which are of frequent occurrence in South Africa, cause a diminution of phosphorus in the leaves of veld grasses and that some of the phosphorus passes back into the roots and eventually, it is thought, back to the soil. In studying the phosphorus and calcium content of veld grasses on the Natal coast and southern Zululand along with the available phosphorus and calcium in their corresponding soils, the same author found a relation to exist for phosphorus but not for calcium and remarks, "It appears that most of the investigated grasses are poor in phosphorus, calcium and nitrogen, but rich in sodium chloride. The two grasses which were found nearly everywhere, *Digitaria natalensis* and *Themeda triandra* (coast form), have to be considered as poor grasses. Some of the grasses like *Panicum maximum* and *Dactyloctenium aegyptiacum* respond to a better soil and should also benefit by fertilization but others do not show any variation analytically in response to change of soil. Several small *Digitaria* species proved to be good grasses from the point of phosphorus content."¹⁴

It has been found that European grasses growing in Australia have a lower average phosphorus content than when growing in Europe, but are nevertheless markedly richer in phosphorus (when grown in Australia) than are the indigenous Australian grasses.¹⁸

Insufficient iron in the pasturage is the cause in New Zealand of the disease of stock known as "bush-sickness." It is believed that similar diseases in other parts of the world are caused by the same mineral deficiency, among which are "Nakuruitis" (Kenya), "pining" (Scotland), "coast-disease" (Tasmania) and "salt-lick" (Florida).⁵ In New Zealand the iron in the soil is present largely in the form of silicate of iron which is insoluble and more or less unavailable to plants. Excess of manganese in the soil is also suggested as a factor which limits the assimilation of iron. In "bush-sickness" investigations in New Zealand it has been shown⁴ that the amount of iron in the pasturage varies with the season and the age of the plant or part of the plant in question. In contrast to phosphorus in South African veld grasses it is found to be least in those parts of the plant developed in the spring and greatest in the tissue of late summer and autumn. New Zealand grown cocksfoot (*Dactylis glomerata* L.) and other grasses were found to possess a lower iron content in the "bush-sick" areas than elsewhere. Among introduced clovers, which constitute the bulk of the grazing in some

areas, this difference was even more marked and plants from the "bush-sick" areas were found to contain considerably less iron than those from "healthy" pastures. Even in "healthy" pastures in New Zealand the figures for iron have been found to be persistently lower than those for the same clover grown in Europe.

The disease known as "Nakuruith" which occurs in the neighbourhood of Nakuru in Kenya is of rather special interest. Orr²⁰ describes the disease and its occurrence as follows:—"Working oxen, after being in the area from four to six months, begin to suffer from anaemia, emaciation, running at the eyes," and in the advanced stages loss of power and co-ordination of the limbs. If the animals be removed to the Sodal Plain, a few miles off, they recover in one to three months, and can be brought back to work within the area for a further period. The condition resembles "bush-sickness" in New Zealand. A remarkable feature of this disease is its disappearance within the last ten years from two areas, viz.:—(a) land in the immediate vicinity of the town of Nakuru, and (b) an area used as a remount camp during the war. In both of these areas there has been a large amount of material brought in and left in the soil. It looks as if the deficiency in the soil, which was the cause of the disease, has been made good, at least to the extent which enables oxen to graze for a year or longer without showing signs of the disease. In some recent tests which have been carried out it has been found that animals allowed to lick ad lib. a mixture of equal parts of common salt and ferric oxide remain healthy, while control animals on the same pasture, but without the salt lick, develop the typical symptoms of the disease."

A common symptom in grazing animals of mineral deficiency in the pasturage is the development of depraved appetite. In the case of phosphorus this leads to the chewing of old bones and carcass debris often resulting in carrion poisoning. "Lamsiekte" in South Africa has been shown to be directly due to the toxin secreted by an organism infecting carcass debris which enters the animal's system through this habit of bone-chewing. It has been observed that in areas where a deficiency in common salt exists and salt-licks are generally provided that animals, particularly sheep, are liable to acquire a depraved appetite for many toxic plants if they do not procure sufficient salt.⁶

Depraved appetite may develop in stock through causes other than mineral deficiency. In areas in the United States where "loco" poisoning occurs (due to certain species of *Oxytropis* and *Astragalus*), which is a malady that does not become manifest until prolonged feeding on the plant has taken place, it has been observed²² that some animals acquire such a liking for the plant that they refuse to eat anything else right up to the time of death. Regarding the somewhat peculiar symptoms of this disease Marsh²² states:—"Horses formerly quite gentle become uncontrollable and shy violently at imaginary objects or leap high over some slight

obstruction. Generally speaking a locoed horse can be neither led nor backed, and when put in motion cannot easily be stopped or turned, but may continue until it runs against a fence or other obstruction." It is stated to be almost impossible to drive in any one direction a flock of sheep that have been "locoed."

The horsetail (*Equisetum* sp.) is another plant for which horses are said sometimes to acquire a depraved appetite in America.

From the facts outlined in this article it is apparent the term "poisonous plant," when used in connection with the pasturage or food-plants of grazing animals, has come to assume a wide significance. It is now commonly used not only for those species that are acutely poisonous but also for plants that in any way disturb the health of stock. There can be little doubt that those plants that must be consumed in quantity over a long period before harmful results to the animal appear, which, of course, includes those causing deficiency diseases, are of far greater moment to the live-stock industry throughout the world than are the more rapid-acting drastically poisonous species.

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XXXIX—CONTRIBUTIONS TO THE FLORA OF TROPICAL AMERICA : XV.*

T. A. SPRAGUE AND N. Y. SANDWITH.

THE GENUS CERATOPHYTUM.

One of the chief difficulties encountered in naming Bignoniaceae is the fact that in many cases both flower and fruit are required in order to determine the genus. Hence it has often happened that the same species has been described separately under two or more genera. In 1916 Urban based a new species, *Anemopaegma tobagense*, on flowering material (Broadway 3493) from the island of Tobago. He gave no indication of its position within the genus *Anemopaegma*, but described the corolla-tube as "pulverulentotomentosulus," and the ovary as "oblongo-lineare," two characters which actually are exceptional in the genus. In 1921 *Anemopaegma tobagense* was found by Dr. N. L. Britton (no. 2834) in Trinidad, also in the flowering condition, and in 1925 was re-discovered in Tobago by Mr. R. O. Williams (Herb. Trin. 11,165), this time in the fruiting state.

In 1928 Dr. H. Pittier described a remarkable new genus of Bignoniaceae which he named *Ceratophytum* in allusion to the horn-shaped woody capsules. This included two species, both natives of northern Venezuela. As Dr. Pittier observed, *Ceratophytum* is clearly related to *Distictella* (*Distictis* Bur., non Mart.); it differs in having gland-fields below the nodes, an abbreviated subcorymbose inflorescence, a lepidote calyx, and elongated tapering fruits. The

*Continued from K.B. 1932, 406.

two species are woody climbers with trifoliate leaves in which the terminal leaflet may be replaced by a trifurcate tendril.

Material of the fruiting specimen of *Anemopaegma tobagense* collected by Mr. Williams in Tobago was subsequently received at Kew, when it was recognized that it belonged to the genus *Ceratophytum*. In the absence of flowers, however, it could not be identified with either of Dr. Pittier's species. The receipt from Mr. Broadway of flowering and fruiting material (no. 9060) of *A. tobagense* collected near the type-locality now enables us to correlate the Tobago species with the Venezuelan ones.

The chief differences between *Ceratophytum capricorne* Pittier and *C. brachycarpum* Pittier seem to be as follows:—

C. capricorne: Leaflets more or less obovate. Anther thecae about 3 mm. long. Capsule about 40 cm. long, non-punctate. Seeds 4·5–5 cm. broad.

C. brachycarpum: Leaflets ovate-elliptic. Anther thecae 4 mm. long. Capsule 16–24 cm. long, lepidote-punctate. Seeds about 3·3 cm. broad.

Anemopaegma tobagense has the following corresponding characters: Leaflets ovate-elliptic. Anther thecae 4·5 mm. long. Capsule 22–27 cm. long, lepidote-punctate. Seeds 3·3–4 cm. broad.

As will be seen, none of the characters mentioned serves to distinguish *A. tobagense* from *C. brachycarpum*, and we accordingly unite these two species.

The synonymy and geographical distribution of the two species of *Ceratophytum* are given below.

***Ceratophytum* Pittier** in Journ. Wash. Acad. Sc. xviii. 62 (1928).

***C. capricorne* Pittier**, l.c. 63.

VENEZUELA. Federal District: between Caracas and La Guaira, Pittier 11527! Without locality, Fendler 2359!

***C. tobagense* (Urb.) Sprague et Sandwith**, comb. nov.—*Anemopaegma tobagense* Urb. in Fedde, Repert. xiv. 311 (1916). *Ceratophytum brachycarpum* Pittier in Journ. Wash. Acad. Sc. xviii. 65 (1928).

VENEZUELA. Aragua: near Garabato, Pittier 11805! Carabobo: La Sanguijuela, Pittier 9153. Guárico: near El Sombrero, Pittier 12,366. Lara: near Sarare, Pittier 11,754.

TRINIDAD. Near Rio Grande, Britton 2834!

TOBAGO. In Scoby's land north-west of Curator's house, Broadway 3493. Scarborough (near the type-locality of no. 3493), Broadway 9060! Stoer Bay, R. O. Williams in Herb. Trin. 11,165!

BRITISH GUIANA or SURINAM. Cabalebo Falls, Corentyne River, in Thurn!

According to Pittier, the corolla of *C. capricorne* is white with a yellow throat, and that of *C. brachycarpum* is entirely white. In Trinidad and Tobago, however, the corolla of *C. tobagense* is white with a yellow throat, according to Broadway, Britton and Williams. We do not attach much importance to this difference in colour.

The capsule valves of *C. capricorne* are described by Pittier as longitudinally sulcate and carinate in the middle, and those of *C. brachycarpum* as slightly channelled. This character may perhaps depend on the age of the fruit, immature capsules of *C. tobagense* from Tobago (*Broadway* 9060) having a strong median rib on each valve, whereas an old valve (*Williams* 11,165) is definitely channelled.

XL—CONTRIBUTIONS TO THE FLORA OF TROPICAL AMERICA: XVI. N. Y. SANDWITH.

NEW SPECIES AND FIRST RECORDS FROM BRITISH GUIANA,
MAINLY COLLECTED BY MR. T. A. W. DAVIS.

The species dealt with below were mainly collected on a very important expedition to the interior of British Guiana which was made by Mr. T. A. W. Davis, Assistant Conservator of Forests, between June and November, 1931. Mr. Davis made numerous camps in the savannah and forest country of the Rupununi and Takutu Rivers and their tributaries, and was able to explore the base and slopes of the Kanaku Mountains which were made famous by the Schomburgks in their accounts of *Strychnos toxifera* and the Cock-of-the-Rock. He also spent five days on Mount Kusad, an isolated forest-clad range rising out of the savannahs on the south side of the Kanaku range.

As is well known, the Schomburgks collected extensively in this district, but few experienced botanists have been there since 1845, although some river-bank collections were made in recent years by Mr. J. S. de la Cruz. Mr. Davis, whose main object was to tour the balata forests of the Rupununi District, was able to leave the river-banks and to penetrate into the forests, where he cut down examples of many of the larger trees, especially of those which seemed to be of ecological importance. The herbarium material is of the very best quality, and its examination shows that Mr. Davis has discovered some fine new species of large trees, has re-collected many of the Schomburgks' species, and has also made numerous first records for the Colony. Some of the latter are of trees which had been collected before by Ule in similar country on the neighbouring Rio Branco. More interesting is the appearance in British Guiana of several species which have recently been described by Dr. Ducke from the forests of northern tributaries of the Amazons; good examples of these are *Hirtella obidensis* Ducke, *Alseis longifolia* Ducke and the remarkable new monotypic genus *Lepidocordia* Ducke, species collected previously only on the lower Rio Trombetas and Rio Branco de Obidos. In this connexion, Mr. Davis has made some interesting observations in an account of his expedition which, it is hoped, will be published later when all the species of ecological importance have been identified. He infers from them that the flora of the forest area of this region is more closely allied to that of

the Amazonian forests than to that of the Guiana rain-forest lying to the north-east; and he thinks it probable that these forests represent a pre-climax of the Amazons rain-forest.

A few other notes of interest are added, and all species which appear from the evidence of the Kew Herbarium to be first records for the Colony are marked with an asterisk. The descriptions of two new *Pipers*, which were collected by the Oxford Expedition in 1929, have been kindly contributed by Dr. Trelease and are inserted at the end of this paper.

VIOLACEAE.

Rinorea endotricha *Sandwith*, sp. nov.; *R. Martini* (Turcz.) Blake affinis, petiolis glabris, sepalis parce tantum pubescentibus vel glabris, antheris apice exappendiculatis differt; a *R. sylvatica* (Seem.) Kze. foliis ramulis petiolisque glabris, sepalis fere glabris vel glabris, petalis extra glabris sed intus pilosulis, filamentis glanduliferis longe recedit.

Arbor humilis, ramulis summis tenuibus glabris (raro parcissime hirtellis) fusco-rubris leviter costatis, internodiis summis 1.5–6 cm. longis. *Folia* ovata usque lanceolata, apice longe (nonnunquam usque 2 cm.) acuminata, basi obliqua margine superiore in petiolum superius rotundata et saepius etiam cordata inferiore rotundata, 9–12.5 cm. longa, 3.2–5 cm. lata, chartacea, glabra, subtus subglaucescentia, marginibus obscure crenulato-serratis, nervis primariis utroque costae latere 12–15, his cum rete venularum supra tenuibus subtus valde prominentibus rete intricatissimo; petiolus brevissimus, 2–3 mm. longus. *Stipulae* in ramulis novellis saltem persistentes, subulatae, 4–5 mm. longae, costato-striatae, parce pubescentes vel subglabrae. *Racemi* breves, 2–4 cm. longi, densiflori, satis dense hirtelli; bracteae sepalis similes, lanceolatae, acutissimae, ad 3.5 mm. longae, valde costato-striatae, pubescentes usque subglabrae; bracteolae similes sed breviores, 2–2.5 cm. longae; pedicelli hirtelli, 2–4 mm. longi. *Flores* albi. *Sepala* ovato-lanceolata, acutissima, 4–4.5 mm. longa, ad 2 mm. lata, extra valde costato-striata marginibus membranaceis ciliatis sparse praesertim superne pubescentia demum subglabra vel glabra, intus glabra. *Petala* sepal paulum tantum excedentia, oblonga vel obovato-oblonga, obtusa vel subacuta, 6 mm. longa, circiter 2.3 mm. lata, apice patula, conspicue ciliata, extra glabra, intus inferne glabra sed dimidio superiore conspicue pilosula. *Stamina* circiter 4 mm. longa; filamenta 0.5–0.7 mm. longa, circiter 0.4 mm. lata; glandula filamentum excedens, 0.8 mm. longa, parte libera brevi apice obtuso rotundato; antherae lanceolato-oblongae, 1.8 mm. longae, 0.6 mm. latae, apice nudae exappendiculatae; squamae connectivi lanceolatae, ad 3.3 mm. longae, 1–1.2 mm. latae, integrae. *Ovarium* globosum, 1.2 mm. longum atque diametro, flavescenti-pilosum; stylus rectus, 3–3.5 mm. longus, basi pilosa excepta glaber; placentae 3–4, 2-ovulatae. *Fructus* ignotus.

BRITISH GUIANA. Simuni Creek, Rupununi River, August 1931, Davis in *Forest Department* no. 2127: an undergrowth tree, growing in miscellaneous forest on top of a low hill at about 350 ft., very common; flowers pure white.

The most remarkable characteristic of this species is certainly the indumentum of the inner surface of the petals, which is not usual in American species of *Rinorea*. But, apart from this feature, the long striate bracts, bracteoles and sepals, and the short racemes, give this species a facies which is shared, in the Kew Herbarium, by *R. sylvatica* alone. The latter plant, however, differs widely in important characters, as may be seen from the diagnostic paragraph given above. *R. Martini*, which was collected in Cayenne, is not represented at Kew, but is apparently quite distinct from the present species, possibly even more distinct than has been assumed here; for, if Blake was right (see Contr. U. S. Nat. Herb. xx. 507) in believing that Oudemans' figure and description of *Alsodeia flavescens* probably represent the same plant as *R. Martini*, then *R. Martini* has sepals only 2 mm. long and petals 2.5 mm. long (see Arch. Néerl. ii. 195, pl. iv.). There is, however, at least one discrepancy between Turczaninov's and Oudemans' descriptions, the former describing the leaves as glabrous, whereas the latter writes of them as pubescent above and hirtellous beneath on the nerves. Turczaninov unfortunately omitted to give any dimensions of the floral parts of his species.

***Rinorea Lindeniana** (Tul.) Kze.—*R. micrantha* Ule.

Right bank of Rupununi River a few miles above mouth of Maparri Creek, fl. Sept., Davis in *F.D.* 2169: a small undergrowth tree in rather low miscellaneous forest; fl. creamy-white.

Distr. Trinidad, Northern South America. First record from Guiana.

This agrees excellently with Ule's syntype of *R. micrantha* from the Rio Jurua, Brazil. Both specimens differ from Kew material of *R. Lindeniana* in the smaller sepals which are not conspicuously ribbed, but the two species are united, no doubt with justification, by Melchior in Notizbl. Bot. Gart. Berlin, x. 544-6 (1929).

FLACOURTIACEAE.

***Carpotroche surinamensis** Uitt., e descr.

Simuni Creek, Rupununi River, c. 350 ft., Aug., Davis in *F.D.* 2111: small tree of understory and undergrowth in high miscellaneous forest; fl. white (♂). *Ibid.* (♀), with yellow fruit and pink seeds, *F.D.* 2112. Right bank of Rupununi River a few miles above mouth of Maparri Creek, c. 400 ft., fl. Sept., Davis in *F.D.* 2170: tree of undergrowth and occasionally up to 60 ft. high, in rather low miscellaneous forest near bank of a creek; fl. ♂ only, white, with deep yellow stamens. This has narrower leaves than 2111 and 2112.

Distr. Surinam.

***Casearia Rusbyana Briq.**

Demerara River, 1896, *Jenman* 6892. Camaria Road, Cuyuni River, fl. Dec. 1931, *Lockie* in *F.D.* 2020 : a small tree with scented flowers, used as an emetic and for fuel.

Distr. Eastern Venezuela (Lower Orinoco).

***Banara guianensis Aubl.**

Camaria Road, Cuyuni River, fl. Feb., *Davis* in *F.D.* 1015 : small shrub about 20 ft. high in low second growth ; fl. yellow.

Distr. Panama to French Guiana. Trinidad. Widely spread in Brazil.

VOCHYSIACEAE.

Vochysia crassifolia Warm.

Southern side of Kanaku Mts. ; right bank of Rupununi River near Sand Creek, fl. Oct., *Davis* in *F.D.* 2246 : a small tree about 20 ft. high, growing beside a small creek in small upland savannah at about 1000 ft. ; fl. yellow.

Vernacular name (Arawak), "Iteballi."

Distr. British Guiana, Brazil (Rio Branco, *Ule*).

STERCULIACEAE.

***Guazuma ulmifolia Lam.**

N. side of Kanaku Mts., about 10 miles east of Takutu River, c. 450 ft., Oct., *Davis* in *F.D.* 2204 : tree about 50 ft. high and 8 in. diam., in second growth at foot of the mountains ; fl. yellow with deep red bases to the petals.

Vernacular name (Arawak), "Wonam."

Distr. Tropical America.

ERYTHROXYLACEAE.

Erythroxylum vernicosum O. E. Schulz.

Yupukarri, Rupununi River, c. 400 ft., Sept., *Davis* in *F.D.* 2175 : undergrowth shrub or small tree, in patch of savannah forest ; fl. white.

Distr. British Guiana and Rio Branco, Brazil.

Approaching the var. *oreophilum* O. E. Schulz in *Notizbl. Bot. Gart. Berlin*, vi. 142 (1914), which was collected by *Ule* on the Rio Branco, but the leaves are cuneate or rounded at the base, not emarginate.

MALPIGHIACEAE.

***Diplopterys includens (Bth.) Ndz.—Tetrapteryx ? includens Bth.**

Summit of Tiger Hill, Arawau-Yarakita Portage, N.W. District, May 1929, *Martyn* 70 : liane with very striking yellow flowers. Near Matope Falls, Cuyuni River, Feb. 1931, *Martyn* 245 : a common bush-rope in morabukea and mixed forest, used as an aphrodisiac and called "Devil-doer" (cf. *Strychnos* spp.).

Distr. French Guiana. Brazil, Venezuela and Peru, if *D. involuta* (Turcz.) Ndz. is considered conspecific.

RUTACEAE.

**Rauia Ulei Krause.*

Kartabo Road, fl. Feb., *Davis in F.D.* 1021 : undergrowth shrub on hill slope in mixed forest, on brown sandy loam ; fl. white.

Distr. Brazil (Rio Acre, *Ule* 9495 !).

OCHNACEAE.

Ouratea superba Engl.

Apoteri, Rupununi River, c. 300 ft., fl. June, *Davis in F.D.* 2061 : tall shrub growing at edge of a backwater, deeply inundated during the rainy season ; fl. yellow.

Distr. British Guiana and Rio Branco, Brazil.

BURSERACEAE.

**Protium Sagotianum March.*

Simuni Creek, Rupununi River, c. 350 ft., Aug., *Davis in F.D.* 2126, 2139 : trees about 60-80 ft. high and 6-12 in diam. in miscellaneous forest on high slope on gravelly soil ; fl. white, sweet-scented.

Vernacular name (Arawak), " Kurokai " (black kind).

Distr. Surinam, French Guiana.

Protium crenatum Sandwith, sp. nov. ; *P. Copal* (Schlecht. et Cham.) Engl. affinis, foliis conspicue crenato-serratis, petalis sparse puberulis tantum statim distinguitur.

Arbor excelsa, circiter 30 m. alta, ramulis summis pubescentibus lenticellatis. *Folia* imparipinnata, petiolo rhachi gracili subtereti petiolulis costa nervisque minute puberulis vel demum fere glabris ; petiolus 2.5-8 cm. longus ; internodia rhacheos 2-4.8 cm. longa ; petioluli 3.5-8 mm. longi ; foliola opposita, 3-4-juga, nonnunquam in foliis inflorescentias subtendentibus 1-2-juga, lanceolata usque oblonga, apice acuminata, basi rotundata lateribus inaequalibus, 5-12 cm. longa, 2.1-4.5 cm. lata, costa nervisque saepe minute puberulis exceptis glabra, chartacea, nitidula, marginibus nisi basin versus integris conspicue crenato-serratis, nervis primariis utroque costae latere 12-15 supra tenuibus subtus prominentibus, rete venularum supra impresso vix cernendo subtus subtilissimo satis conspicuo. *Inflorescentiae* e basi ipsa multiramosae, ramis ipsis simplicibus, ramis basalibus saepe brevibus multifloris confertis, anguste pyramidal-thyrsoideae, folium subtendens haud aequantes, 4-18 cm. longae, puberulae ; rami inferiores (suprabasales) nonnunquam 5 cm. longi ; cymae brevissime pedunculatae vel sessiles ; pedicelli 0.5-1.5 mm. longi. *Calyx* turbinatus, 1-1.5 mm. longus, 2-2 mm. latus, utrinque puberulus ; lobi late ovati, magnitudine variabili, usque 0.4 mm. longi. *Petala* 4-5, ovato-lanceolata usque ovata, obtusa, 2.8-3 mm. longa, 1.5-1.75 mm. lata, apice recurvata, utrinque sparse puberula. *Stamina* 8-10, filamentis glabris 1.5 mm. longis, antheris nigrescentibus 0.5 mm. longis. *Discus* glaber, apice plano-umbilicatus, conspicue 8-10-lobatus atque sulcatus, 2 mm.

diametro. *Ovarium* globosum, pilosum, in disco immersum, 0.3 mm. longum, 0.5 mm. diametro, stylo brevissimo. *Fructus* non visus.

BRITISH GUIANA. Northern side of Kanaku Mountains, about 10 miles east of Takutu River, Sept. 1931, *Davis* in *Forest Department* no. 2195 : a tree about 100 ft. high and 18 in. diam., in miscellaneous forest at the foot of the mountains at about 450 ft. ; flowers green.

Vernacular name (Arawak), "*Kurokai*," a name given to other species of *Protium*.

The crenate-serrate leaflets recall those of the Asiatic *P. serratum* (Colebr.) Engl.

****Tetragastris panamensis* (Engl.) O. Kze.**

N. side of Kanaku Mts. about 10 miles east of Takutu River, c. 450 ft., Oct., *Davis* in *F.D.* 2197 : tree about 60 ft. high and 10 in. diam. in miscellaneous forest at foot of mountains ; fl. pale green, white inside corolla tube.

Vernacular name (Arawak), kind of "*Haiowaballi*."

Distr. Central America to French Guiana, see R. Benoist in *Bull. Soc. Bot. France*, lxvi, 360 (1919).

MELIACEAE.

****Trichilia* (§ *Moschoxylum*) *Smithii* C.DC.—*T. oblanceolata* Rusby. *T. cruegeriana* Urb.**

N. side of Kanaku Mts. about 10 miles east of Takutu River, c. 450 ft., Oct., *Davis* in *F.D.* 2211 : tree about 70 ft. high and 8 in. diam., in miscellaneous forest near bank of creek at foot of mountains ; fl. green with a whitish staminal tube.

Distr. Colombia, Trinidad.

****Trichilia* (§ *Apotrichilia*, *fide* C.DC.) *surumuensis* C.DC.**

N. side of Kanaku Mts., about 10 miles east of Takutu River, c. 450 ft., Sept., *Davis* in *F.D.* 2189 : undergrowth tree about 15 ft. high and 2 in. diam., on bank of a stream in Kokerite (*Maximiliana*) forest fringing foot of mountains ; calyx and corolla pale green, staminal tube white and translucent.

Distr. Rio Branco (*Ulé*!).

***Trichilia* (§ *Choriopetion*) *leucastera* Sandwith, sp. nov. ;** inter species huius sectionis a *T. lepidota* Mart. foliolis 4-jugis acuminatis statim distinguenda ; a *T. Schumanniana* Harms atque *T. angustiore* Harms pilis stellatis plerumque cinereo-albis, inflorescentia pyramidalis multo magis florifera ramis longis multifloris, floribus minoribus differt ; a *T. Taubertiana* Harms foliolis haud bullatis recedit ; a *T. stelligera* Radlk. foliolis 4-jugis nervis lateralibus magis numerosis, inflorescentia magna multo longiore, petalis intus basi tantum glabris, staminibus omnino liberis facile distinguitur.

Arbor satis excelsa ; ramuli summi costati, pilis stellatis pallide brunneis dense tomentelli. *Folia* magna 25–38 cm. longa, petiolo rhachi petiolulis indumento stellato dense tomentellis ; petiolus supra applanatus, 7–9.5 cm. longus ; internodia rhacheos supra

leviter canaliculata, 2.5–5 cm. longa; petioluli 2–6 mm. longi; foliola 4–juga, opposita vel alterna, ovato-oblonga, oblongo-lanceolata, vel oblanceolata, terminalia obovato-lanceolata, apice breviter sed conspicue cuspidata, basi cuneata usque obtusa (foliola terminalia valde cuneata), 5.5–15 cm. longa, 2.3–7.2 cm. lata, firme chartacea, supra pilis stellatis albescentibus per costam nervosque satis densis ceterum sparsis pubescentia, subtus similiter sed densius induta, costa nervisque primariis supra impressis subtus prominentibus, venulis supra vix cernendis subtus tenuissimis satis conspicuis luce transmissa pellucidis, nervis primariis utroque costae latere 12–18 ascendentibus. *Inflorescentiae* magnae, pyramidales, 10–24 cm. longae, foliis subtendentibus breviores, pilis stellatis densis cinereo-albis ubique tomentellae; rami valde floriferi, ramulosi, primarii inferiores saepe 6.5–10.5 cm. longi; pedicelli vix ad 2 mm. longi; bracteae subulatae, circiter 1 mm. longae, bracteolae breviores. *Flores* pentameri, statu vivo cremeo-albi, odori. *Calyx* cupularis, ad 1.5 mm. longus, extra stellato-tomentellus, intus glaber, dentibus late deltoideis acutis circiter 0.5 mm. longis. *Petala* libera, ovato-lanceolata, obtusa, 3.2–3.5 mm. longa, ad 1.5 mm. lata, extra dense subsericeo-cinereo-tomentella, intus basin versus glabra ceterum pulverulento-puberula. *Stamina* 10, libera, filamentis glabris a basi sensim angustatis inaequalibus ad 2 mm. longis apice brevissime bidentatis; antherae globosae, 0.3–0.5 mm. longae atque latae. *Ovarium* triloculare, loculis biovulatis, dense cinereo-stellato-pilosum, applanato-pulviniforme, circiter 1.75 mm. diametro; stylus brevis, tumidus, glaber, cum stigmate rotundato-obtusum 0.7 mm. longus. *Fructus* ignotus.

BRITISH GUIANA. Simuni Creek, Rupununi River, Aug. 1931, Davis in *Forest Department* no. 2140: tree about 80–90 ft. high, 14 in. diam., with slightly fluted base to the trunk, in miscellaneous forest at 350 ft.; flowers creamy-white, sweet-scented.

Vernacular name (Arawak), *Ulu*; but this is also given to species of Burseraceae.

Trichilia (§ Eutrichilia) Davisii *Sandwith*, sp. nov.; *T. triphyllae* Blake e descriptione affinis, indumento foliolorum, inflorescentiis brevissimis congestifloris, praesertim calyce profunde lobato differt; a *T. flava* C.DC. foliolis 1–3 tantum, calyce majore profunde lobato, praeterea a *T. Goudotiana* Tr. et Pl. atque *T. montana* Kunth ob indumentum foliolorum pauciorum statim distinguenda; *T. palmatorum* Pittier foliolis obovato-oblongis apice emarginatis supra glabris e descriptione optime differt.

Arbor parva, ramulis teretibus dense flavescenti-tomentosis, nonnunquam ob tomentum delapsum glabrescentibus tum striatis purpurascensibus lenticellatis. *Folia* trifoliolata vel unifoliolata atque sub lamina articulata, 9.5–21 cm. longa, petiolo rhachi petiolulisque indumento ramulorum tomentosis; petiolus 2–5 cm. longus; internodium rhacheos cum petiolulo terminali 0.4–1.8 cm. longum; petioluli laterales (atque in foliis pseudosimplicibus

terminales) 2-3 mm. longi ; foliola (lateralia opposita) ovata, ovato-oblonga, elliptica, vel oblongo-elliptica, apice breviter acute cuspidata, basi cuneata acuta usque obtusa vel in foliolis lateralibus subrotundata, terminalia 8.5-15.2 cm. longa, 4.6-8 cm. lata, lateralialia atque solitaria minora 4.8-11.5 cm. longa, 3-6.5 cm. lata, chartacea, supra costa tomentosa ceterum ubique plus minusve pubescentia, subtus ubique praesertim costa nervisque molliter pilosa subvelutina, nervis primariis utroque costae latere 10-15 arcuato-ascendentibus atque prope marginem anastomosantibus, rete venularum supra subtilissimo inconspicuo subtus laxiore prominente. *Inflorescentiae* brevissimae, ad 1.5 cm. longae, saepius circiter 1 cm. diametro, densiflorae, a basi ramosae, ubique dense flavescenti-villosulae ; pedicelli usque 2 mm. longi ; bracteae bracteolaeque lanceolatae, 1.5-2.2 mm. longae, 0.5-1 mm. latae. *Calyx* extra dense flavido-villosulus, profunde 4-partitus, lobis ovato-lanceolatis 1.5-1.75 mm. longis ad 1.2 mm. latis. *Petala* 4, libera, obovato-oblonga, 4.5 mm. longa, ad 2.5 mm. lata, extra praesertim dimidio superiore pubescentia, intus furfuraceo-puberula. *Tubus staminalis* 1.75 mm. longus, apice circiter 2.75 mm. diametro, glaber, basi carnosus-incrassatus ; filamenta libera 8, pilosa, dentibus apicalibus inclusis 1.5 mm. longa, saepe fere ad 1 mm. lata, dentibus 0.5 mm. longis ; antherae pubescentes, 0.75 mm. longae. *Ovarium* dense longe villosum, subgloboso-conoideum, 0.5 mm. longum atque diametro ; stylus sparse pilosus, cum stigmate capitato 1 mm. longus. *Fructus* ignotus.

BRITISH GUIANA. Rupununi River, on the right bank a few miles above the mouth of the Maparri Creek, Sept. 1931, *Davis* in *Forest Department* no. 2167 : an undergrowth tree, about 25 ft. high and 8 in. diam., growing on and among boulders at summit of a mountain in ? *Attalea* sp. forest at 1000 ft. ; flowers cream.

Guarea Davisii *Sandwith* sp. nov. ; foliolis 4-5-jugis satis paucinerviis, inflorescentiis plerumque e ramulis vetustioribus orientibus, floribus magnis tetrameris, calyce magno bilabiato-fisso, ovario hirsuto distinguenda ; *G. Ulei* C.DC. atque *G. suberosa* C.DC. floribus (praesertim calycibus) multo minoribus differunt ; *G. Poeppigii* C.DC. e descriptione inflorescentiis dense flavido-villosis, floribus sessilibus, nervis foliolorum lateralibus magis numerosis differt ; *G. fissicalyx* Harms foliolis 6-7-jugis angustioribus, inflorescentia longiore, petalis 5, antheris 10-13, stylo inferne piloso e descriptione valde differt ; *G. pubiflora* Juss. folii rhachi marginato-alata, inflorescentiis e foliorum axillis orientibus, petalis extra magis flavido-sericeis differt.

Arbor parva, circiter 12 m. alta. *Folia* magna, usque 44 cm. longa, petiolo rhachique exalata angulatis glabris, petiolo 6-8 cm. longo, internodiis rhacheos 4.3-6.5 cm. longis, petiolulis glabris nigris supra canaliculatis 3-5 mm. longis ; foliola 4-5-juga, opposita vel fere opposita, inferiora ovata, cetera satis anguste oblonga usque oblanceolata, apice usque 2 cm. cuspidata vel acuminata, basi cuneata acuta, 9-22 cm. longa, 5-8.5 cm. lata, chartacea, glabra,

creberrime punctulata, utrinque pulchre intricate reticulata, nervis primariis utroque costae latere circiter 10-12 laete arcuantibus atque fere margine ipso anastomosantibus. *Inflorescentiae* e ligno vetere exorientes, nonnunquam in ramulis novellis axillares, anguste thyrsoidaeae, simplices vel basi pauciramosae, satis breves, 3-18 cm. longae, adpresse cinereo-pubescentes; cymae breviter pedunculatae, 3-florae vel sursum 1-florae, pedicellis brevibus 1-3 mm. longis; bracteae bracteolaeque minutae, dense pubescentes. *Calyx* irregulariter bilabiatus 4-lobatus, 4-5 mm. longus, extra siccitate purpureus satis sparse minute pubescens, intus glaber venosus; lobi ovati, usque 3 mm. lati, saepe angustiores. *Petala* 4, lanceolata, 8.5 mm. longa, ad 3.25 mm. lata, apice incrassata inflexa, extra indumento duplici (pilis aliis satis longis minimis aliis) adpresse pubescentia, intus trientibus duobus superioribus pulverulenta ceterum glabra. *Tubus stamineus* cylindricus, 6.5-7 mm. longus, glaber, margine crenulato-sinuato; antherae 8 infra apicem insertae, fere 1 mm. longae. *Gynophorum* late stipitiforme, 0.75 mm. longum, glabrum, tum in discum ovario latiore apice pilosum dilatatum. *Ovarium* conoideum, circiter 2 mm. longum atque diametro, dense flavescenti-pilosum; stylus glaber, sulcatus, ad 4 mm. longus, stigmate discoideo circiter 1 mm. diametro. *Fructus* ignotus.

BRITISH GUIANA. Apoteri, Rupununi River, July 1931, *Davis* in *Forest Department* no. 2092: a small tree about 35 ft. high and 3 in. diam., in miscellaneous forest on hill slope at 300 ft.; flowers milk-white, sepals cream, some dashed with red, strongly scented; inflorescences cauliflorous on branches and axillary on younger shoots.

Vernacular name (Arawak), *Kufiballi* ("resembling the Coffee tree").

**Cedrela odorata* L. sens. Ducke et Harms.

Simuni Creek, Rupununi River, c. 350 ft., Aug., *Davis* in *F.D.* 2117: large tree 120 ft. or more high, 3 ft. diam., buttressed with high thick buttresses to about 7 ft., in miscellaneous forest; fl. pale green.

Local name, "Red Cedar" (brown kind).

Distr. West Indies to the Amazons.

OLACACEAE.

**Clavapetalum elatum* (Ducke) Ducke.—*Asterolepidium elatum* Ducke.

Wismar, Aug. 1924, *Persaud* 113: tree on river bank; fl. brown.

Distr. Brazil (Pará). Perhaps conspecific with *C. surinamense* Pulle of Surinam, which has not been examined.

RHAMNACEAE.

**Zizyphus Cinnamomum* Tr. et Pl.

S. side of Kanaku Mts., right bank of Rupununi River near Sand Creek, c. 1200 ft., Oct., *Davis* in *F.D.* 2243: tree about 100 ft. high

and 16 in. diam., on hill slope in forest, very abundant ; fl. green with yellow disc.

Distr. Colombia (*Linden* 1548 !), Venezuela (Valencia, *Funck* 794 !).

Probably conspecific with *Z. melastomoides* Pittier. *Z. Cinnamomum* is not given in Pittier's list of the Venezuelan species of *Zizyphus* in his *Quinta Decada de Arboles y Arbustos Nuevos de Venezuela* (1925), but *Z. melastomoides* is recorded from near Valencia.

ANACARDIACEAE.

**Loxopterygium Sagoti* Hk. fil.

Karakara Creek, Demerara River, Feb. 1910, *C. W. Anderson* in *F. D.* 175. Mora-mora-bisi Creek, Mapenna River, Corentyne River, May 1918, *Hohenkerk* in *F. D.* 175A. Apoteri, Rupununi River, July 1931, *Davis* in *F. D.* 2100 : tree about 100 ft. high and 20 in. diam. on gentle slope in rather low miscellaneous forest ; latex pale greenish-yellow, thick and sticky, it raises blisters on the skin of some people.

Vernacular name (Arawak), " Hububalli."

Distr. French Guiana.

LEGUMINOSAE.

**Myroxylon* sp.

Foot of Kanaku Mts., near source of Moco-Moco Creek, Takutu River, c. 400 ft., fl. Oct., *Davis* in *F. D.* 2203 : a large tree, 120-130 ft. high, about 24 in. diam., near foot of a mountain slope amongst boulders in miscellaneous forest.

Vernacular name (Wapisiana), " Sirkir " ?

This is the first certain record from British Guiana of this famous genus, but readers of Richard Schomburgk's travels will find that when staying at Watu-Ticaba, S. of the Kanaku Mountains, he noted that the Wapisiana women wore necklaces made of the seeds of *Myroxylon*, and was told that the trees grew in abundance at a distance of two days' journey from the village (see Roth, *Transl.*, ii. p. 307). Mr. Davis' discovery of *Myroxylon* in this region is an interesting confirmation of this statement. In the absence of fruit and seeds, it is impossible to decide whether his material should be referred to *M. peruiferum* or to *M. Balsamum*.

**Ormosia Coutinhoi* Ducke.

Mahaica Camp, Moblissa Path, Demerara River, fl. March, 1910, *C. W. Anderson* in *F. D.* 582. Bartica-Potaro Road, 54th mile, *Dawson* in *F. D.* 2013 : tree 60 ft. high in wallaba forest on white sand ; fl. a soft purplish colour.

Distr. Brazil (Pará, *Ducke* 15491 !).

**Parkia nitida* Miq.—*P. ingens* Ducke.

Simuni Creek, Rupununi River, N. of Kanaku Mts., c. 350 ft., fl. Aug., *Davis* in *F. D.* 2116 : tall tree, 125 ft. high, 24 in. diam.,

strongly buttressed to about 5 ft., near top of a slope in miscellaneous forest ; filaments of infertile fl. yellow, fertile fl. cream, buds dark brown.

Distr. Surinam, Brazil (Pará).

It does not seem possible to distinguish *P. ingens* from *P. nitida*, which was not mentioned by Ducke in his key to the Brazilian species of *Parkia* in Arch. Jard. Bot. Rio de Janeiro, iv. 35-39 (1925), although he cites both names in his conspectus of the four groups of the genus in Notizbl. Bot. Gart. Berlin xi. 471-2 (1932).

***Parkia Ulei** (Harms) Kuhlmann.—*Leucaena Ulei* Harms.

Yawakuri River, Berbice, fl. June 1919, *Hohenkerk* in *F. D.* 397A : tree 170 ft. high, on brown sand at foot of hill. Simuni Creek, Rupununi River, c. 350 ft., fl. Aug. 1931, *Davis* in *F. D.* 2113 : tall tree about 120 ft. high, 18 in. diam., on sandy clay soil on gentle slope in tall miscellaneous forest ; bole smooth, cylindrical, not buttressed, crown small and flat-topped ; fl. creamy-white.

Vernacular name, " Uya (brown)," *fide* Hohenkerk.

Distr. Widely distributed in Amazonian Brazil. Surinam (*P. microcephala* Kleinh., which is regarded as synonymous with *P. Ulei* by Ducke, see Notizbl. Bot. Gart. Berlin xi. 471).

ROSACEAE.

***Hirtella obidensis** Ducke.

Kanaku Mts., near right bank of Rupununi River a few miles south of Maparri Creek, c. 800 ft., fl. Sept., *Davis* in *F. D.* 2166 : tree about 90 ft. high, 14 in. diam., on steep hill slope on red sand soil in miscellaneous forest with palm (probably *Attalea* sp.) dominant ; petals white ; stamens and style deep pink.

Distr. Amazonian Brazil (near Obidos).

Agreeing very well with *Ducke* 19764 from Juruty Velho.

RUBIACEAE.

***Alseis longifolia** Ducke.

Simuni Creek, Rupununi River, c. 350 ft., Aug., *Davis* in *F. D.* 2145 : tree with fluted bole, about 80 ft. high and 10 in. diam., in miscellaneous forest with Balata ; fl. pale green, sweet-scented.

Distr. Brazil (lower Rio Trombetas and Rio Branco de Obidos, *Ducke*).

The calyx-lobes of this material are narrower and more ovate-lanceolate than those of *Ducke* 21690, from the lower Rio Trombetas.

Randia asperifolia (Sandwith) Sandwith comb. nov.—*Basanacantha asperifolia* Sandwith in Kew Bull. 1932, 470.

This species is now placed in *Randia* in order to fall into line with the view current among American botanists.

***Guettarda acreana** Krause.

Apoteri, Rupununi River, c. 300 ft., fl. June, *Davis* in *F. D.* 2065 : tree of second story or lower part of canopy, with slightly fluted trunk

and large crown, growing in miscellaneous forest on rather low ground; fl. greenish-white.

Distr. Brazil (Rio Acre, *Ule*!).

Differs from the type material (*Ule* 9709) in the pubescent hypanthium. The following additional collections have been received which seem to be referable to this species: Mt. Iramaik-pang, Kanaku Mts., 1200 ft., Aug. 1932 (leaves only), *Fr. Mather*, S.J. in *F. D.* 2302; and Lower Camaria, Cuyuni River, fr. Sept. 1932, *Davis* in *F. D.* 2317. The last collection bears fruits which are black, terete, and glabrous, ovoid-ellipsoid, 7 mm. long and 4-6 mm. diameter, crowned with the very inconspicuous remains of the calyx.

Vernacular name (Arekuna), "Yakki." The bark is used by the Makusi Indians in the preparation of the arrow-poison "curare," and the tree is probably well distributed in the Pacaraima region.

It is misleading to describe the calyx of *Guettarda* as invariably truncate. That of the present species is conspicuously lobate, the remains of the lobes surviving on the mature fruit. For similar calyces, compare *G. Tournefortiopsis* Standley, *G. discolor* Rusby or *G. hirsuta* (R. & P.) Pers.

****Appunia aurantiaca*** (*Krause*) *Sandwith* in Kew Bull. 1931, 472.

North side of Kanaku Mts., about 10 miles east of Takutu River, c. 450 ft., Oct., *Davis* in *F. D.* 2222: shrub about 4 ft. high, at the edge of forest bordering savannah; fl. pure white.

Distr. Bio Branco (*Ule*!).

Agrees perfectly with *Ule*'s specimen but the pure white flowers (*Ule* described them as yellowish-orange) remove one of the few good distinctions between this species and its very close ally *A. tenuiflora* which has been frequently collected in British Guiana.

Rudgea tanaosepala *Sandwith* sp. nov.; facie *R. Hostmannianae* Benth., forma stipularum, bracteis laciniisque calycinis longe subulato-filiformibus, stigmatibus nunc papillatis nunc dense lanatis valde distincta.

Frutex humilis: ramuli summi novelli compressi, minute puberuli vel glabrescentes, ad 2.5 mm. lati. *Folia* oblanceolata, apice longe attenuata acute acuminata, basi longe attenuata cuneata, 8.5-17 cm. longa, 2.1-5.3 cm. lata, firme chartacea, glabra, supra siccitate olivacea vel saepius nigrescentia, subtus pallide viridia, nervis primariis utroque costae latere 10-12 patulo-adscendentibus utrinque cum venulis laxè haud valde reticulatis: petiolus 3-6 mm. longus, glabratus vel minute puberulus. *Stipulae* glabrae, vagina 2-3 mm. longa, apice integra truncata, sed infra apicem dentibus 4 subulatis nonnunquam bifidis 3-6 mm. longis praedita, praeterea utroque axis latere dente 7-9 mm. longo 1-1.75 mm. lato apice bifido saepius etiam lacerato-fimbriato dentes ceteros superante infra apicem instructa. *Inflorescentia* terminalis, passim pilosula, brevis, 2-3 cm. longa, 2-3.5 cm. lata, thyrsoidea, inferne dichasiis verticillatim dispositis; pedunculus basalis 0.7-1.3 cm. longus, pedunculi

dichasiorum 3-8 mm. longi; bracteae bracteolaeque anguste subulato-filiformes, bracteae 7-9 mm. longae, bracteolae paulo breviores. *Flores* sessiles, albi, petalis in alabastro cornutis. *Hypanthium* 1.75 mm. longum, 1.2 mm. latum, glabrum vel superne parce puberulum. *Calycis* dentes subulato-filiformes, 4.5-5.2 mm. longi, igitur hypanthio multo longiores, conspicue pilosuli. *Corollae* tubus 7 mm. longus, extra glaber, intus sub fauce dense lanatus ceterum glaber; lobi oblongo-lineares, 5-6 mm. longi, minute pulverulenti, sub apice cornibus sparse pilosulis 1.2-2 mm. longis instructi. *Stamina* vel sub fauce inclusa subsessilia vel longe exserta filamentis 6 mm. longis; antherae usque 2.2 mm. longae, in staminibus inclusis breviores. *Stylus* 1 cm. longus; in flore staminibus inclusis praedito cum stigmatibus dense papillatus; in flore staminibus longe exsertis praedito glaber stigmatibus dense lanato-pilosis.

BRITISH GUIANA. Simuni Creek, Rupununi River, August 1931, *Davis* in *Forest Department* no. 2149: a low and bushy undergrowth shrub about 3-8 ft. high, in mora forest at about 350 ft.; flowers white.

The long subulate calyx-teeth of this plant are evidently shared by very few other species of the genus, the only good example met with being *R. discolor* Benth. The dimorphism in the indumentum of the style and stigmas, in conjunction with that of the stamens, is very peculiar and suggests interesting adaptations for purposes of cross-fertilisation. Hairy styles or stigmas are already known in *R. lasiostylis* Müll. Arg. and *R. lasiostylis* Krause (the latter species presumably requires a new name), but this part of the flower is hardly mentioned in many recent descriptions and might repay further study.

BORAGINACEAE.

**Cordia trichotoma* (Vell.) Arrab. ex Steud.

N. side of Kanaku Mts., about 10 miles E. of Takutu River, c. 450 ft., Oct., *Davis* in *F. D.* 2221; small tree about 15 ft. high, 3 in. diam., in low secondary forest near the edge of the savannah; fl. pure white, calyx green with silvery scales. Pirara (Marakanata), Rupununi Savannahs, c. 400 ft., Sept., *Davis* in *F. D.* 2186: tree about 68 ft. high and 15 in. diam., on sandy soil in patch of savannah forest on top of a ridge; leaves and buds glaucous green.

Vernacular names, "Taparai" (Wapisiana); Brown Silverballi (Arawak).

Distr. E. Brazil to Paraguay, N. W. Argentina, and Bolivia; also on the Rio Branco, Brazil. See I. M. Johnston in *Contr. Gray Herb.* xcii. 15 (1930).

Agrees with *Ule* 8292, from the neighbouring Rio Branco, which is referred to *C. trichotoma* by Johnston.

**Lepidocordia punctata* Ducke in *Arch. Jard. Bot. Rio de Janeiro* iv. 171, pl. 22 (1925).

Right bank of the Rewa River, about 14 miles S.S.E. of its mouth, (i.e. confluence with Rupununi River), c. 300 ft., July, *Davis* in *F. D.* 2082 : tree about 100 ft. high and 24 in. diam. or more, deeply fluted, growing in Balata (*Mimusops*) forest on a low hill with red clayey soil.

Distr. Brazil (Rio Branco de Obidos, *Ducke*!).

An interesting extension of the range of a recently described and most unusual tree. The type locality in Brazil is also on a red-clay soil, where the tree flowers from November to January (*fide* *Ducke*, l.c.).

LAURACEAE.

Aniba anisosepala *Sandwith* sp. nov. ; *A. Brittenii* Mez ob perianthii lobos perinaequales similis, ab hac foliis multo latioribus basi ipsa in petiolum rotundatis, inflorescentia ampla multiflora puberula statim distinguitur.

Arbor parva, circiter 18 m. alta ; ramuli summi glabri, pallide purascentes, subteretes, lenticellati, apicem versus 3 mm. diametro. *Folia* ramulos terminantia, congesta, obovato-elliptica, apice abrupte conspicue acuminata vel fere cuspidata, basin versus longe attenuata sed basi ipsa in petiolum manifeste rotundata, 11–18.5 cm. longa, 4.5–6.8 cm. lata, firme chartacea, glabra, utrinque satis opaca, costa nervisque primariis utrinque prominentibus, reticulatione supra immersa subtus satis prominente sed tenui, nervis primariis utroque costae latere vulgo 12–16, in medio costam angulo circiter 60° relinquentibus, satis longe (in medio folio nonnunquam ad 1 cm.) a margine anastomosantibus ; petiolus supra canaliculatus, 4–7 mm. longus. *Inflorescentiae* apice ramulorum pseudoterminales, aggregatae, multiflorae, foliis multo (saepe dimidio) breviores, ad 11 cm. longae, anguste pyramidales, fere ubique cinereo-puberulae, pedunculo primario purpurascente basi glabrescente ; pedicelli in perianthii tubum sensim transientes, dense cinereo-puberuli vel tomentelli, sulcati, tubo incluso 1.75–3.2 mm. longi. *Perianthium* cremeum ; tubus anguste obconicus, in pedicellum sensim transiens, apice haud constrictus sed in limbum abrupte transiens ; limbus subglobosus, ad 1.8 mm. diametro ; lobi valde inaequales, intus concavi, ciliati ac utrinque puberuli ; exteriores interioribus multo minores, deltoideo-ovati, obtusi, 0.75 mm. longi, 0.5–0.6 mm. lati ; interiores ovati, obtusi, 1.25 mm. longi, ad 1.25 mm. lati. *Stamina* serierum duarum exteriorum introrsa ; filamenta utrinque lanatopilosa, 0.5–0.7 mm. longa, antheris aequilata vel paulo angustiora et multo longiora ; antherae late ovatae vel suborbiculares, connectivo supra loculos rotundato-obtuso, 0.25 mm. longae, ad 0.4 mm. latae, glabrae ; series tertia similis, extrorsa, glandulis sessilibus obovoideo-oblongis ad 0.5 mm. longis ad 0.3 mm. latis. *Ovarium* brunneum, glabrum, ellipsoideo-fusiforme, 1.2 mm. longum, ad 0.5 mm. latum, in stylum brunneum glabrum ad 0.75 mm. longum transiens ; stigma pro rata magnum, nigrum, irregulariter plano-discoideum,

0.75 mm. diametro. *Fructus* maturus ignotus ; iam valde immaturus ovoideo-ellipsoideus, 1.5–2.5 mm. longus, ad 1.5 mm. diametro, perianthii tubo immersus atque lobis coronatus.

BRITISH GUIANA. Kanaku Mts., near Nappi Creek (a tributary of the Pirara River), c. 800 ft., Oct. 8th, 1931, *Davis* in *Forest Department* no. 2216: a small tree, about 60 ft. high and 6 in. diam., growing in miscellaneous forest on top of a ridge with reddish, sandy, loam soil ; flowers cream.

***Acrodictidium debile** Mez in Jahrb. Bot. Gart. Berlin, v. 99 (1889) descr. ex inflorescentiis plane evolutis ampliata.

Arbor parva vel frutex, circiter 6 m. alta ; ramuli summi graciles, tenues, cinnamomei, pubescentes, hornotini saepe basi dense fulvopilosuli ; internodia ramulorum hornotinorum 3.5–4.5 cm. longa. *Folia* opposita, elliptica usque ovato-elliptica, apice satis abrupte longe conspicue caudato-acuminata, acumine 1.2–2.4 cm. longo, basi cuneata saepius acuta, 8.2–14.5 cm. longa, 2.9–5.5 cm. lata, chartacea, utrinque satis nitida, supra juventute sparse adpresse pilosa mox glabra costa nervisque minute puberulis exceptis, subtus ubique sparse adpresse pilosa, nervis primariis utroque costae latere circiter 6–8 inter se longe a margine (in medio folio 0.5–1.5 cm.) arcuato-anastomosantibus, his cum costa supra satis obscuris subtus prominentibus, rete venularum intricato utrinque sed praesertim subtus manifesto ; petiolus gracilis, supra canaliculatus, minute puberulus, 6–7 mm. longus. *Inflorescentiae* in ramulis hornotinis ex axillis cataphyllorum exorientes, oppositae, nonnunquam pseudo-terminales, gracillimae, flexuoso-arcuatae, 2–8 cm. longae, floribus ipsis exceptis ubique inconspicue pubescentes, inferne nudaе, dimidio superiore ramosae, ramis imis ad 1.5 cm. longis, floribus apice ramorum subumbellatis 3–5 vel raro singulis ; pedicelli 2.5–6 mm. longi. *Flores* albi. *Perianthium* omnino glabrum tubo intus piloso excepto ; tubus obconicus, apice haud constrictus, circiter 1.3 mm. longus, 1.7 mm. latus ; lobi subaequales, late ovato-suborbiculares, rotundato-obtusi, circiter 1 mm. longi atque lati. *Stamina* glabra, serierum 2 exteriorum staminodialia ; series prima foliacea, sessilis, quadrato-rotundata, circiter 0.6 mm. longa atque lata ; secunda obovato-spathulata, ad 0.7 mm. longa, lamina semi-orbiculari ad 0.4 mm. lata, filamentum angustiore distincto laminam aequante ; series tertia fertilis, extrorsa, 1 mm. longa, 0.6 mm. lata, filamentum antherae aequilato sed longiore, connectivo supra loculos brevissime producto rotundato-obtuso, glandulis minimis circiter 0.25 mm. longis atque latis. *Ovarium* glabrum, ovoideum, 1 mm. longum, ad 0.7 mm. diametro, in stylum glabrum 1 mm. longum transiens, stigmatem minuto inconspicuo. *Fructus* ignotus.

BRITISH GUIANA. Kanaku Mountains ; near Nappi Creek (a tributary of the Pirara River), c. 700 ft., Oct. 8th, 1931, *Davis* in *Forest Department* no. 2218: a small bushy undergrowth tree or shrub, about 20 ft. high and 3 in. diam., growing on a steep slope in miscellaneous forest ; flowers white.

FRENCH GUIANA. Without locality, *Patris* 53 (typus in Herb. Candoll., Geneva !).

An interesting rediscovery of a rare and little-known species.

**Silvia Duckei* (Sampaio) Sampaio.—*Misanteca Duckei* Sampaio.

Kanaku Mountains, near source of Moco-Moco Creek, Takutu River, c. 600 ft., *Davis* in *F. D.* 2196 : tree about 80 ft. high, 16 in. diam., in miscellaneous forest on a steep rocky slope ; fl. green.

Distr. Rio Branco, Brazil.

**Ocotea canaliculata* (Rich.) Mez.

Mazaruni Station, June 1932, *Davis* in *F. D.* 2291 : tree of main canopy, specimen taken from coppice shoot in heavily burnt secondary forest on light brown sand soil ; fl. pale greenish-yellow.

Vernacular name (Arawak), "White Silverballi."

Distr. Trinidad to French Guiana and N. Brazil.

PROTEACEAE.

Roupala suaveolens Klotzsch var. *minor* Meisn. e descr.

Kusad Mountain, Southern Rupununi Savannas, c. 1300 ft., fl. Oct., *Davis* in *F. D.* 2226 : tree about 50 ft. high and 8 in. diam., on a steep rocky slope near summit of mountain ; fl. creamy-yellow.

Distr. Endemic.

LORANTHACEAE.

**Psittacanthus plagiophyllus* Eichl.

Issororo Creek, Pomeroon River, Feb., *Davis* in *F. D.* 2266 : parasitic shrub, apparently peculiar to *Didymopanax Morototoni*, in second growth forest.

Vernacular name (Arawak), "Werokarotika."

Distr. Amazonian Brazil.

TRIURIDACEAE.

**Sciaphila purpurea* Benth.

Simuni Creek, Rupununi River, c. 350 ft., Aug., *Davis* in *F. D.* 2150 : saprophyte with deep plum-coloured flowers growing in miscellaneous forest.

Distr. Brazil : Panuré, Rio Uaupes, *Spruce*.

Spruce collected it on termites' nests on trees, more rarely on the ground. The British Guiana material agrees very well with his specimens, which were gathered in January 1853.

NEW PIPERACEAE COLLECTED BY THE OXFORD EXPEDITION, 1929
(WM. TRELEASE).

Piper moraballianum Trel. sp. nov.

Frutex parvus ; internodia floralia gracilia, brevia, subtiliter velutina. *Folia* lanceolata vel lanceolato-elliptica, acuminata, basi obtusa aequilatera vel subacuta uno latere brevior, 8–16 cm. longa, 3–8 cm. lata, e dimidio inferiore pinnatinervia, nervis majoribus utroque costae latere 4–5 sursum arcuato-anastomosantibus, subtus nervis velutina, glandulis numerosis minutis pellucidis, siccitate

membranacea nigrescentia ; petiolus in foliis aequilateris 5 mm. longus ac alatus, vel 1-4 mm. longus exalatus, velutinus. *Spicae* 1.5 cm. longae, 2 mm. latae, apiculatae ; pedunculus filiformis, 5 mm. longus, velutinus ; bractae rotundato-subpeltatae, ciliolatae ; stigmata sessilia.

BRITISH GUIANA. Moraballi Creek, Essequibo River, 1929, *Sandwith* 361 (typus) atque 19 (Herb. Kew.) : low shrub in forest ; leaves obscurely downy beneath.

Piper Wachenheimii *Trel.* sp. nov.

Frutex parvus, siccitate nigrescens ; internodia satis gracilia, brevia, pilis rectis dense rubro-pubescentia. *Folia* lanceolata usque elliptica, subcaudate acuminata, basi cuneata, 11-15 cm. longa, 4-6.5 cm. lata, e dimidio inferiore pinnatinervia, nervis majoribus utroque latere costae 4-5, leviter revoluta, supra glabra nitida, subtus glanduloso-granulosa in nervis venisque longioribus rubro-hirsuta ; petiolus circiter 10 mm. longus, rubro-hirsutus, haud vaginans. *Spicae* 0.4-8 cm. longae, cuspidatae ; pedunculus 5-10 mm. longus, rubro-hirsutus. *Baccae* depresso-globosae, apice umbilicatae, granulosa ; stigmata 3, sessilia.

FRENCH GUIANA. Godebert, *Wachenheim* 168 (Herb. Paris.).

BRITISH GUIANA. Moraballi Creek, Essequibo River, *Sandwith* 231 (typus in Herb. Kew.).

XLI—NEW OR LITTLE-KNOWN PLANTS FROM SOUTH INDIA: II.*

Arisaema Wightii Schott was first described in Bonplandia, 7, 26 (1859) from *R. Wight* 2774, now in the Herbarium of the Berlin Museum. There is no indication on the sheet as to the locality except the Kew distribution label bearing the printed heading "Peninsula Indiae Orientalis," so that Schott's authority for citing the habitat as : "Carnatic, Malabaria," is not known to me. *Wight* 2773 in the Kew Herbarium, which contains this and another species of *Arisaema*, is from the Nilgiri Hills of S. India.

In De Candolle's Monogr. Phaner. 2, 555 (1879), Engler united *A. Wightii* Schott with the earlier *A. Jacquemontii* Bl., a Himalayan plant. He did not cite Wight's specimen but mentioned *Hohenacker* 2164a from "Canara, Mangalor." In Pflanzenr. 4, 23 F, 196-7 (1920), however, Engler reconsidered his verdict and separated the two species again. Under *A. Wightii* he there quoted *Wight* 2774 together with a sheet of W. A. Talbot as derived from "Mysore, Kadua" (misprint for Kadur) ; but it is only Talbot's sheet that is from Mysore. This specimen is in fruit and is, I consider, not *A. Wightii* but *A. Leschenaultii* Bl. *Hohenacker* 2164a, previously cited, was altogether omitted under all three of the above species, unless, indeed, the citation was misprinted under the last named as *Hohenacker* 20504. As far as I am aware the *Hohenacker* numbers

*Continued from *K.B.* 1932, 247.

from S. India (collected for him by Metz) run to well below 6000, and as the next cited number is *Gamble* 20514, I think it is quite probable that 20504 is a slip for 2164a.

Professor E. Barnes of the Christian College, Madras, recently sent to Kew a number of specimens collected by him in the Nilgiri Hills, including a series of *Arisaema* most carefully and beautifully prepared, accompanied by photographs, notes and in two cases specimens in formalin. One of these is undoubtedly *A. Wightii* Schott, the others, as the collector himself points out, though allied, are distinct. These specimens have led me to revise the conception of *A. Wightii* that I had formed when working on the genus for the Flora of the Presidency of Madras, to separate out one new species which I had confused with *A. Wightii*, and to recognise two further new ones in the new material.

The material of *A. Wightii* as defined by me previously is all in a more or less dilapidated condition, hardly permitting a precise conception. From a scrutiny of the material now available and comparison with Wight's sheets (including the type, kindly lent by the Berlin Herbarium) and other sheets previously identified as this species, I have come to the conclusion that both Engler and myself confused two species and that the true *A. Wightii* Schott is confined to the Nilgiri Hills at elevations above 6000 ft. It is possible, however, if not probable, that further exploration will furnish specimens from the Anaimalai and Palni Hills. Further, I am inclined to think that Engler was right in combining *A. Wightii* Schott with *A. Jacquemontii* Bl. The absence of the plant from the areas between the Himalayas and the Nilgiri Hills does not invalidate this, since there is no region there of suitable climate and elevation. In contrast *A. tortuosum* Schott, being more accommodating, occurs in both ranges and also in intervening places at lower elevations. Nevertheless, not having seen the sheets of Jacquemont quoted by Blume, I do not at present propose to reunite them.

In view of this confusion and the rather meagre description given by Schott, I append an amplified description, based principally on Professor Barnes' excellent specimens. The three new species are also described below and the four may be distinguished as follows :

Limb of spathe expanded ; leaflets 5-7 :—

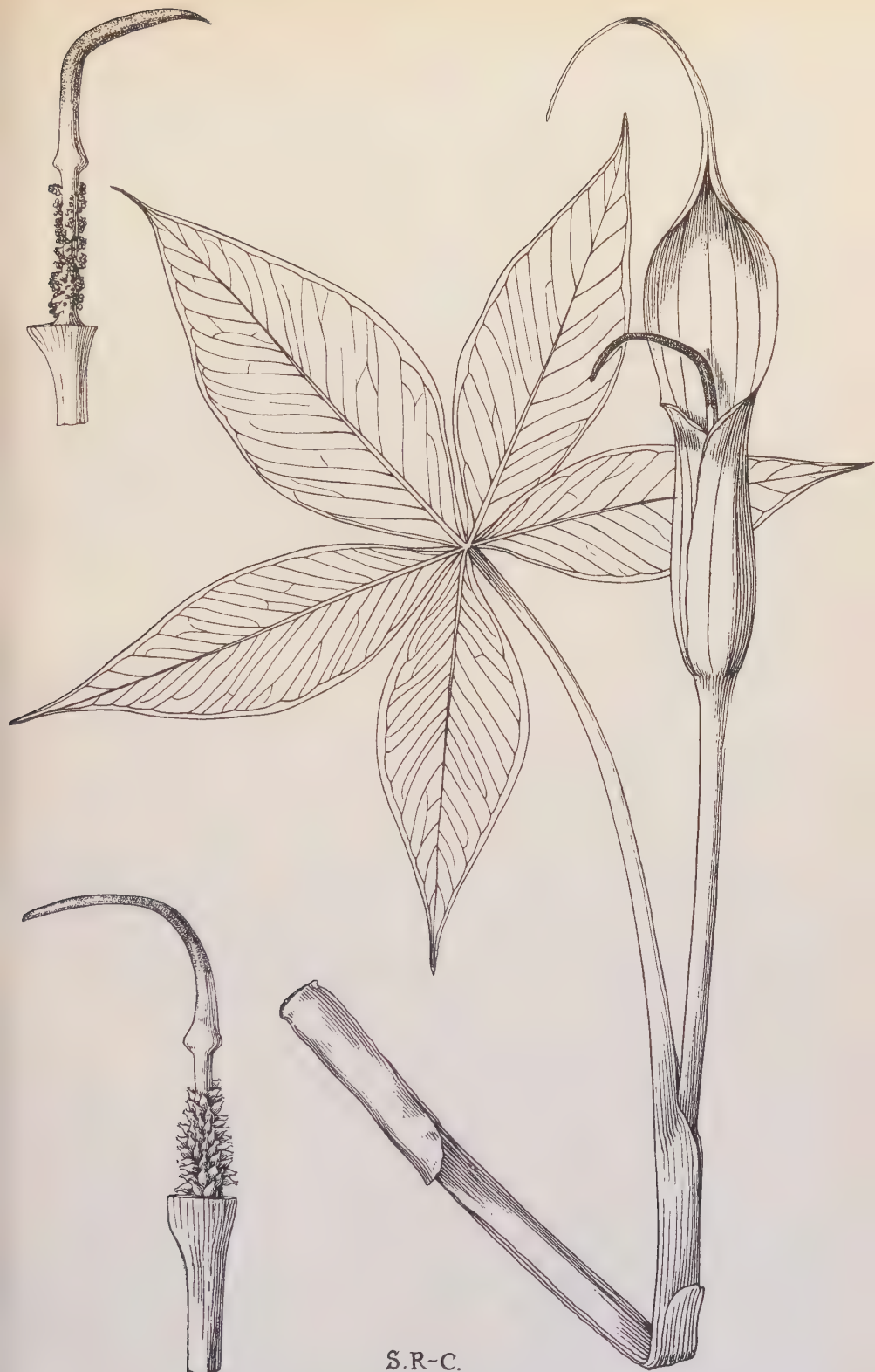
Leaflets 5, sessile or only the middle one very shortly petiolulate ;
 appendix abruptly swollen a little above the inflorescence.....
Wightii

Leaflets usually 7, sometimes 5, all distinctly petiolulate ; appendix
 not abruptly swollen :—

Limb of spathe dark-purple, tapering into a tail ; spadix not
 recurved*Barnesii*

Limb of spathe bright-green, suddenly narrowed into a tail ;
 appendix recurved at the apex.....*tylophora*

Limb of spathe cucullate ; leaflets 9-11.....*translucens*



S.R-C.

Fig. 1. *Arisaema Wightii* Schott. $\times \frac{3}{4}$.

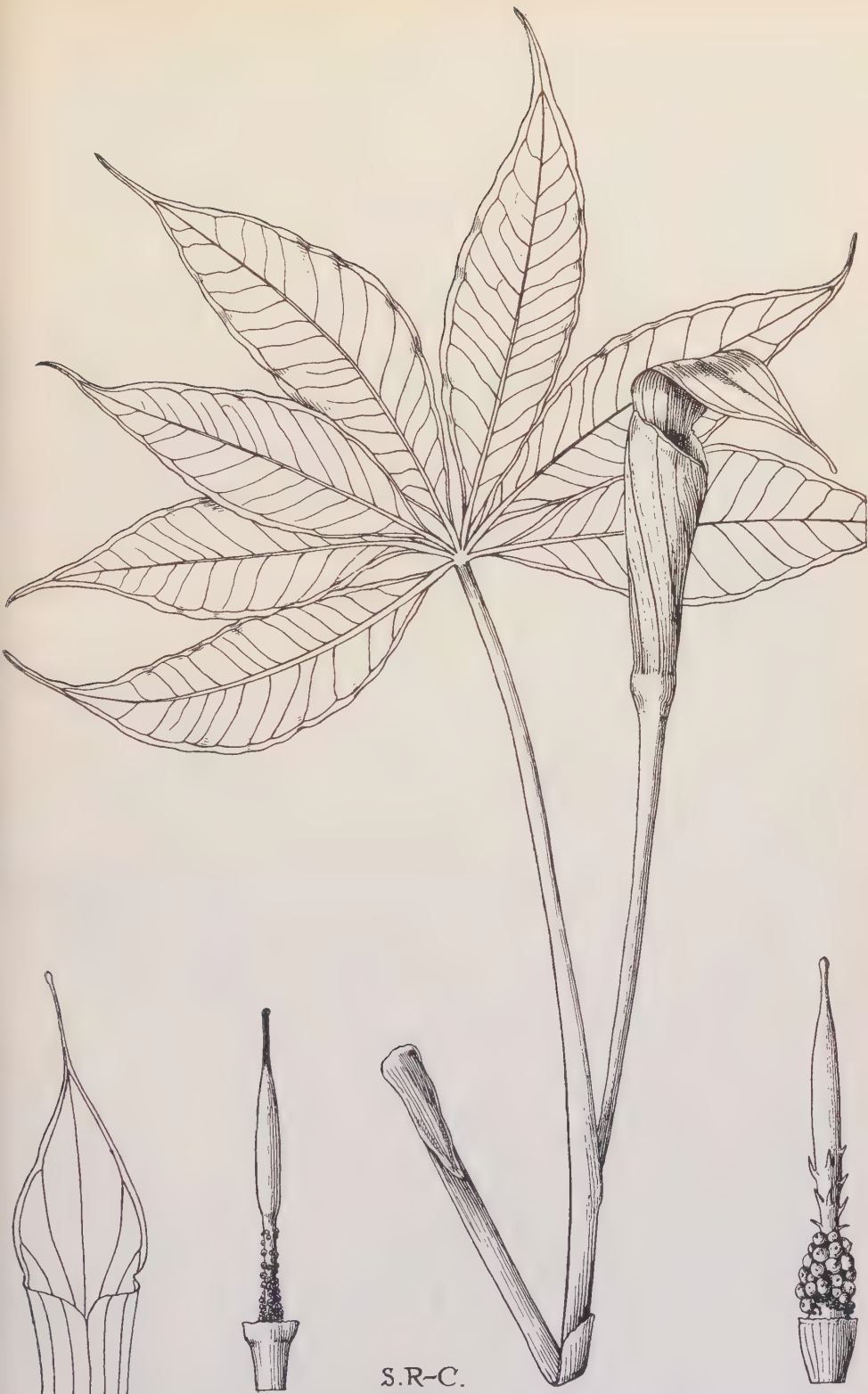
Arisaema Wightii Schott [Araceae-Aroideae].

Tuber subglobose, 1-1.3 cm. diam., flesh white. *Cataphylls* 3, lax, up to 24 cm. long, apex rounded, pale-greenish, almost white. *Petioles* 1-2, 27-48 cm. long, sheathing to above the middle, terete above, pale-green, mouth of sheath obliquely rounded; *segments* 5, radiate, elliptic-ovate to -obovate, acuminate, base acute, sessile or the median very shortly petiolulate, 2.4-10 cm. long, 1.2-5 cm. wide, primary nerves 8-12, arising at an angle of 45° from the midrib, 5-7 mm. apart, uniting in a submarginal vein 4-6 mm. from the entire margin with a more slender vein between, the nerves sometimes forked. *Peduncle* like the upper part of the petiole, usually shorter, sometimes longer, 24-49 cm. long. *Spathe* bright-green with 5 white vertical streaks and some fine white lines; tube nearly cylindric, 3-7 cm. long, about 1.2 cm. diam. in the middle, where it is widest, margin at mouth slightly revolute; limb ovate-boat-shaped, tapering into a curved filamentous appendage 6-9.5 cm. long, the apical half of which is almost black. *Spadix* dioecious, 7-8.8 cm. usually the ♀ longer than the ♂. ♀ *inflorescence* cylindric, 2.2-2.4 cm. long; *ovaries* crowded, pear-shaped, green with yellow streaks, 3 mm. long; *style* short, thick; *stigmas* minutely puberulous, surrounded by a black ring; *ovules* 4-5; *neuters* 0; *appendix* abruptly widened, sometimes truncately, at 5-8 mm. above the ovaries, then tapering to a long blunt point, white below, purple and recurved in the upper half. ♂ *inflorescence* 2-3.3 cm. long, cylindric; *stamens* scattered, filaments thick, white, up to 1 mm. long; *anthers* broadly reniform, dark-purple, opening by an oblong slit; *neuters* 0; *appendix* like that of the ♀ but usually stouter, sometimes bent at a right angle and the tip more acute.

Wight 2774 without locality (type in the Berlin Herb.); Nilgiri Hills at Avalangy (Avalanche), about 7000 ft., fls. Oct., *Wight* 2773 (2 only out of 4 plants on the sheet); *Wight* without number or locality (in Kew Herb.), left hand plant only; Coonoor, fls. Sept., *G. King* without number; Shola in Hill West of Makurti Peak, 8000 ft., fls. June, *E. Barnes* AR.5.

Arisaema Barnesii C. E. C. Fischer, sp. nov. [Araceae-Aroideae]; *A. Wightii* Schott affine, sed minus, foliorum segmentis omnibus petiolulatis, spadice haud abrupte incrassata, appendice apice capitulata.

Tuber subglobose, 1-1.5 cm. diam. *Cataphylls* 3, lax, apex rounded, lowest short, becoming chaffy, uppermost up to 14 cm. long. *Leaf* solitary; *petiole* 20-40 cm. long, sheathing for about half its length, mouth of sheath oblique with 2 small rounded or subacute lobes; *segments* radiate, 5-7, distinctly petiolulate, elliptic-lanceolate, acuminate at both ends, 8-15 cm. long, 2.2-4.5 cm. wide, the lateral very slightly smaller, primary lateral nerves 9-18, 3-5 mm. apart, not very distinct from the secondaries, arising at an angle of 45° from the midrib, uniting in an intramarginal vein 2-3 mm. within the entire margins; *petiolules* 0.8-2 cm. long. *Peduncle*



S.R.-C.

Fig. 2. *Arisaema Barnesii* C. E. C. Fischer. $\times \frac{3}{4}$.

terete, 8–30 cm. long. *Tube of spathe* cylindric or very narrowly funnel-shaped, 5–7.5 cm. long, about 1 cm. diam., vertically striped with a number of dark-purple and whitish bands, margins united only at the base, slightly revolute at the mouth; *limb* horizontal, ovate, 3.5 cm. long, tapering into a filiform tail 0.8–3.3 cm. long, sometimes terminated by a minute knob, dark-purple streaked outside with green. *Spadix* straight; ♂ 5–6 cm. long, floriferous portion 1.5–2.2 cm. long, slightly tapering from a base 3 mm. in diam., bearing short, low, irregular, narrow ridges; *stamens* scattered, *anthers* subglobose, sessile or nearly so, purple, opening by a pore; *neuters* 0 or 1–2 above, subulate; *appendix* narrowly fusiform, widest at the middle, tapering to a short tail with a small minutely warted apical knob, dark-purple or pale below and the apex dark-purple, the basal portion with a few narrow ridges. ♀ *spadix* 7 cm. long, floriferous portions 1.7–1.9 cm. long; *ovaries* crowded, 3 mm. diam., subglobose, green, sometimes mixed below with a few purple stamens; *style* minute; *appendix* like that of the ♂ but rather stouter, greenish, purplish upwards, with a few subulate neuters on the lower third, above these up to halfway a few laminate ridges (fused neuters?).

Nilgiri Hills: Longwood Shola at Kotagiri, 6000 ft., fls. May, *E. Barnes* A.R.3 b. & c. (type in Kew Herb.); Gudarmalai, *E. Barnes* A.R.3a. N. Coimbatore: Bellaji, 5000 ft., fls. March, *C. E. C. Fischer* 900. S. Coimbatore: Anaimalai Hills at Sholear, 3300 ft., fls. May, *C. E. C. Fischer* 1951. "What appears to be the same plant was found in a shola near Naduvattam; the spathe of this is green and white instead of purple and white" (Barnes).

Arisaema translucens *C.E.C. Fischer*, sp. nov. [Araceae-Aroideae]; *A. Wightii* Schott affine, sed spathae limbo cucullato translucido-vittato differt.

Tuber subglobose, 1.5 cm. diam., flesh white. *Cataphylls* 3, lax, uppermost 9 cm. long, apex rounded, pinkish-purple, lowermost becoming chaffy. *Leaf* solitary; *petiole* sheathing the peduncle below the middle, terete above, 35 cm. long, pinkish-purple with brown and pink markings or pink with brown and white markings; *segments* radiate, 9 on the ♂ plant and 11 on the ♀, narrowly elliptic-ob lanceolate, finely acuminate, base tapered, sessile, 9–14 cm. long, 1.7–2.8 cm. wide, dull velvety green above, slightly glossy below, midrib and numerous primary lateral nerves prominent below, the latter 2–3 mm. apart, arising at an angle of about 30° from the midrib, uniting in an intramarginal vein 1–2 mm. within the revolute, erose margins. *Peduncle* about 20 cm. long, resembling the upper part of the petiole, but much more slender. *Tube of spathe* nearly cylindric, slightly widened to the mouth, 3.5–4.3 cm. long, 1–1.3 cm. diam. at the mouth, white with a few vertical green and purple striae; *limb* 2.5 cm. long, with 6 broad purple stripes continued onto the upper two-thirds of the tube, and converging at the apex, the bands between translucent; *limb* cucullate, leaving a narrowly

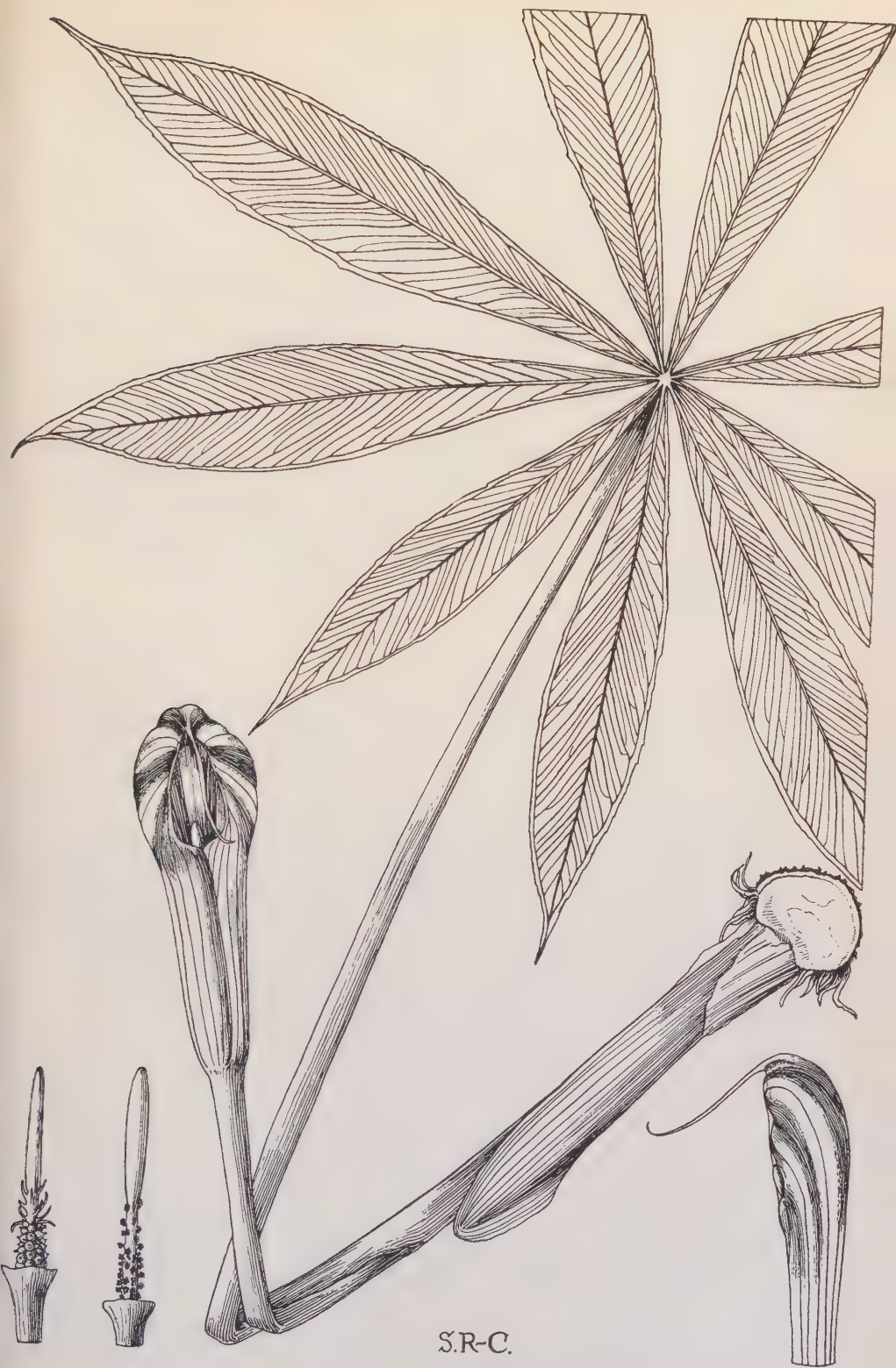


Fig. 3. *Arisaema translucens* C. E. C. Fischer. $\times \frac{3}{4}$.

obcordate opening from the apex of which depends a filiform process 2.5-3 cm. long with an upcurved tip. *Spadix* 4-5.4 cm. long, dioecious, green with faint purple striae, the apical quarter white: ♂ inflorescence 2 cm. long, nearly cylindric; *stamens* scattered, *filaments* thick, up to 1.5 mm. long, *anthers* subglobose, purple, opening by an elliptic pore; *neuters* 0; *appendix* narrowly clavate, slightly narrowed and rounded at the apex; ♀ inflorescence 1-1.5 cm. long; *ovaries* crowded, subglobose, 1.5-2 mm. diam., *style* very short, *stigma* minutely papillose, *ovules* 4; *neuters* above the ♀ inflorescence, scattered, subulate, 5 mm. long, rarely with an anther (functional?) at the tip; *appendix* awl-shaped, apex blunt, sometimes much narrowed below the apex and again slightly widened at the tip.

Nilgiri Hills: Carrington Tea Estate near Thia shola, 6000 ft., fls. June, *E. Barnes* AR.4.

Among the paintings in the Kew Herbarium is one drawn by the late Mrs. A. F. Broun at Travancore in 1929 which appears to be this plant, although the filiform appendage of the spathe is shown much longer and without an upturned tip.

Prof. Barnes writes of this species: "A very characteristic species. I found it on the edge of a shola about a mile south of Thia shola. *Biophytum polyphyllum* is also common there. At first I thought the plant was deformed, but we (my wife and I) soon found other similar ones. The purpose of the arrangement seems fairly obvious; flies of some kind attracted by the smell (not more noticeable than with other *Arisaemas*), settle on the thread-like appendage of the spathe. From this position they are attracted by the white end of the appendix of the spadix, which is clearly visible owing to the light that enters through the translucent parts of the spathe.

Arisema tylophorum C. E. C. Fischer, sp. nov. [Araceae-Aroideae]; *A. Barnesii* C. E. C. Fischer peraffine, sed spathae limbo claro-iridi abrupte-caudato, spadice appendice recurvata differt.

Tuber spherical, 1 cm. diam.; producing bulbils; rootlets red. *Cataphylls* 3, lax, apex rounded, uppermost up to 13 cm. long, spotted with brown, becoming chaffy. *Leaf* solitary; *petiole* sheathing below the middle, light-green marbled with brown and pink, 19-26 cm. or more long; *segments* radiate, usually 7, sometimes 5, petiolulate, elliptic-lanceolate to elliptic-oblongate, acuminate or caudate-acuminate, base acute, 5.3-26 cm. long, 1.6-9 cm. wide, primary lateral nerves 8-17, 5-10 mm. apart, uniting at an angle of 45° with the midrib, uniting in an intramarginal vein 1.5-6 mm. from the erose margin, upper surface dark-green with a waxy lustre, lower bright green and very glossy; *petiolules* 1-1.8 cm. long. *Peduncle* slender, up to 18 cm. long, coloured as the petiole. *Tube of spathe* cylindric or very narrowly funnel-shaped, 2.5-4.5 cm. long, 1-1.2 cm. diam. at the mouth, white with vertical purple stripes within; *limb* bright-green, ovate, abruptly caudate, 1.5-2.5 cm. long, overarching, the filamentous tail 0.8-2 cm. long,



Fig. 4. *Arisaema tylophorum* C. E. C. Fischer. $\times \frac{3}{4}$.

upcurved at the apex and terminated by a distinct small spherical or clavate knob. *Spadix* dioecious or the ♀ with a few anthers among the ovaries; ♂ 4 cm. long, the floriferous portion elongate-conical, 1.2–1.7 cm. long, *stamens* scattered; *anthers* purple, spherical, sessile, opening by a pore; *neuters* 0; *appendix* nearly cylindrical, hardly thicker than the floral axis, narrowed and curved near the apex, terminating in a distinct, minutely-warted knob. ♀ *spadix* 5.5–6.5 cm. long, floriferous portion 0.8–2 cm. long; *ovaries* usually crowded, sometimes a little separated with a few anthers between, globose, green, 2 mm. diam.; *style* stout, 1 mm. long; *stigma* minutely papillose; *ovules* 4–6; *appendix* cylindric, hardly incrassate, beset below with subultrae, rarely forked, neuters up to 6.5 mm. long, attenuate and recurved near the apex, terminating in a subclavate, minutely-warted knob.

Nilgiri Hills: Thaishola, 6000 ft., fls. June, *E. Barnes* AR.6 C, D, E (type in Kew Herb.); Gudarmalai, in wet shola, fls. May, *E. Barnes* AR.6 A, B; Avalanche bungalow, in wood, fls. April, *Viscount Gough* without number.

“This plant was found in flower in a shola about a mile from Naduvattam beyond the Cinchona Plantation, on 17.5.1932, and also on 20.6.1932, and was found to be very common in Thaishola, where many specimens were seen flowering on 16.6.1932. In both these sholas *A. Leschenaultii* Bl. also occurred and also what appeared to be a cross or intermediate form. The spathe had the coloration of the plant described above, but the shape of *A. Leschenaultii*, the appendage was club-shaped, the leaflets were like those described above but were sessile or nearly so” (Barnes).

In addition Professor Barnes has supplied the subjoined notes on two other species:

“AR 1. *Arisaema Leschenaultii* Bl. Very common in Longwood Shola, Kotagiri, flowering in June. A census of all plants seen was taken in respect to the following factors:—(a) sex, (b) number of leaflets, (c) whether left side of spathe overlapped the right, or vice versa. (Right means observer's right.) The following were the results:—

(a) 253 male, 28 female.

(b) male 2 with 5, 5 with 6, 96 with 7, 80 with 8, 50 with 9, 16 with 10, 4 with 11.

female 3 with 8, 6 with 9, 12 with 10, 4 with 11, 3 with 12.

(c) Right side over left, 7 females, 59 males.

Left side over right, 7 females, 45 males.

It is seen that the male plants are about nine times as numerous as females, that male plants mostly have 7, 8, or 9 leaflets, and females mostly have 10, and that half, or a little more, of the plants have the right edge of the spathe overlapping the left.

Female plants were generally larger than males, and were more numerous where conditions were more favourable. The largest male seen was 3 ft. 10 inches high; the largest plant seen was a female,

and had the following measurements : *height* 5 ft. 2 in., *circumference* at least 3 in. from the ground, $6\frac{1}{4}$ in. (it grew in a stream-bed partly choked up with other plants and the bottom of the stem could not be reached), *length of spathe* 11 in., *greatest width* $3\frac{1}{4}$ in., *length of spadix* 6 in., *leaflets* 13 in. by 14 in. (12 leaflets).

One plant found had no leaf, but the spathe was divided into five. Several plants had two leaves, but this is rare.

There is a definite difference in colour of plants found in different parts of the Nilgiris. In Longwood Shola the colour of the spathe is green with white striations and some purple striations inside the tube ; the plants have a tall habit. In a shola on the Kundahs near Pirmund the spathe is dark purple-red with white striations and the plants are very squat with stout stem and spadix. Near Naduvattam the spathe colouration is yellow and white. There is also a great difference in shape of leaflets ; in some plants they are so broad that they overlap, while in others they are quite narrow ; some leaflets were very frilly, while others were flat.

AR 2 *Arisaema tortuosum* Schott. Fifty specimens that were flowering in Banagudi Shola (about 5500 ft.) near Aravenu, in the first week of June were examined. 26 were found to be male, and 24 monoecious.

Monoecious—2 leaves had 7 leaflets, 5 had 8, 32 had 9, 4 had 10, 4 had 11, 1 had 12. Each plant had 2 leaves.

12 had right edge of spathe over left, 3 had left over right, the rest were open so wide as not to overlap.

Males—5 leaves had 5 leaflets, 4 had 6, 37 had 7, 6 had 8. Each plant had 2 leaves. 10 had right edge of spathe over left, 3 left over right, and rest open.

It is seen that about equal numbers of plants are monoecious and male, that the average number of leaflets for monoecious plants is 9 and for males 7, and that generally the right edge of the spathe overlaps the left.

The largest specimen seen was monoecious, and was 3 ft. high. When the spathe withers after flowering it becomes almost white tinted with orange."

Arthraxon depressus Stapf MS. sp. nov. [Gramineae-Andropogoneae]. *A. lanceolato* Hochst. proximus sed robustior, foliis rigidis latioribus, glumis majoribus edentatis differt.

An erect herb. Roots not seen. Culms slender, quite glabrous, leafy. Leaf-sheaths terete, tight, finely ribbed, glabrous, margins ciliate ; ligules thin, scarious, 2 mm. long, erose-truncate, glabrous or sparsely hairy ; blades rigid, narrowly lanceolate, to ovate or elliptic-oblong, acuminate or cuspidate, base cordate, 5-9 cm. long, 1-2.6 cm. wide, 9-15 nerved, glabrous except for short hairs scattered along the midrib below, margins minutely tubercled, often with stiff cilia from the tubercles. Inflorescence terminal, of 2-4 simple or branched peduncled spikes 2-5 cm. long ; peduncles long- or short-exserted,

puberulous or pubescent, at least near the apex ; partial peduncles slender, pubescent, 1-2 cm. long ; joints of the rhachis slightly compressed, very little enlarged at the apex, 3.5-4.3 mm. long, long-ciliate ; pedicels linear, flat, 2.2-3.5 mm. long, long-ciliate, devoid of glumes. *Spikelets* narrowly elliptic. *Callus* 0.07-0.08 mm. long, short-hairy. *Glumes* brown or olivaceous ; the lower subcoriaceous, narrowly lanceolate, apex acute, minutely 2-toothed, 2-keeled with inflexed margins, back nearly flat, 5-6.8 mm. long, 6-7-nerved, nerves, especially the marginal, spinulose at least in the apical half ; the upper chartaceous, deeply plicate-navicular, acuminate or mucronate, 5.4-7 mm. long, keel scaberulous towards the apex. *Lemmas* hyaline, plicate, sometimes brownish, margins ciliate ; the lower 4.6-6.2 mm. long, epaleate and empty ; the upper 4.2-5.6 mm. long, sometimes very shortly 2-lobed, bearing on the back just above the base a geniculate awn 10.7-12 mm. long, the longer part below the knee partly black, striate, glabrous, above slender, pale-brown, minutely ascendingly barbellate ; palea hyaline, narrowly oblong, subacute, 2.5 mm. long. *Floret* ♂, stamens 3, anthers 2.5-3.6 mm. long. *Grain* not seen.

Peninsula, precise locality not indicated, *Herb. Wight* 3372 (type in Kew Herb.) ; Mysore State, Agalatti, 3500 ft., Nov., *Meebold* 10545.

The narrowly lanceolate leaves and the shorter glumes are found in Meebold's specimen.

Arthraxon villosus C. E. C. Fischer, sp. nov. [Gramineae-Andropogoneae] ; ab omnibus congeneribus spicularum sessilibus glumis inferioribus anguste alatis villosis recedit.

A slender *herb*. *Roots* not seen. *Culms* very slender, branched, glabrous except the sparingly hairy nodes. *Leaf-sheaths* lax, much shorter than the nodes, ribbed, sparsely hairy from minute tubercles, ciliate ; ligules very short, membranous, truncate, ciliate ; blades flaccid, lanceolate, acuminate, base subcordate, 3-4.5 cm. long, 1-1.5 cm. wide, softly hairy on both sides and ciliate, all the hairs from minute tubercles. *Racemes* 2, digitate, 2-2.5 cm. long ; peduncles long or shortly exserted, glabrous ; partial peduncles slender, angular, one very short with 1 or 2 solitary sessile spikelets differing from and larger than the rest, followed by a long joint, the other peduncle up to 1 cm. long ; joints of the rhachis slender, depressed plano-convex, 3.5 mm. long, back 3-nerved, white villous, sides long white-ciliate. *Spikelets* 2-nate, except the 1-2 lowest, one sessile the other pedicelled ; pedicels like the joints but wider and not nerved on the back. *Sessile spikelets* at the base very narrowly lanceolate ; lower *glume* with a glabrous oblong callus 1 mm. long, narrowly linear-lanceolate, acuminate, 7-8 mm. long, 7-nerved, back subcoriaceous, slightly convex, margins widely hyaline, 3-keeled above the middle, keels hispidulous ; upper glume plicate, acuminate, chartaceous, white with wide hyaline margins, keeled, glabrous ; *lemmas* hyaline, plicate, acuminate, 4.3 mm. long, the

upper bearing a geniculate awn 11–12 mm. long from a little above the base on the back, paleas 0, floret ♂. The remaining *sessile spikelets* linear-lanceolate; *glumes* dissimilar, the lower with a semi-circular hairy callus 0.6 mm. long, narrowly lanceolate, acuminate, 5.4–6 mm. long, 7-nerved, back slightly convex, subcoriaceous, densely villous, 2-keeled, the membranous, villous margins widely inflexed, keels narrowly winged, wings densely ciliate; upper glume 4.7–5.3 mm. long, plicate, acuminate, white, thinly chartaceous with hyaline margins, keel and sides below the middle puberulous; *lemmas* hyaline, epaleate, lower narrowly oblong, obtuse, 2.7–3.2 mm. long, empty, the upper plicate, acute or acuminate, 3–3.7 mm. long, bearing on the back from a little above the base a fine geniculate awn 11.5–13 mm. long, the shorter portion below the knee pale-brown, smooth, the upper portion darker, at least below, minutely ascendingly barbellate, its floret ♂, lodicules minute, stamens 2 or 3, anthers linear, 1.3–1.9 mm. long. *Grain* not seen. *Pedicelled spikelets* without callus; *glumes* dissimilar, the lower ovate-lanceolate, acute, slightly convex, membranous, 6–8-nerved, 4–4.5 mm. long, pubescent, 2-keeled towards the apex, keels hispidulous; upper glume thinly membranous, white, plicate, acute, 3-nerved, glabrous or sparsely ciliate; *lemmas* hyaline 2.4–2.7 mm. long, narrowly oblong, epaleate, empty.

Bababudan Hills, April, *Sir A. G. and Lady Bourne* without number (type in Kew Herb.).

The single sheet has 3 separate sections of stem, all apparently from the same plant, but the lower part is lacking.

Dimeria bialata C. E. C. Fischer, sp. nov. [Gramineae-Andropogoneae]; *D. pusillae* Thw. var. *Lawsoni* Hook. f. similis, sed rhachibus latioribus, glumis inferioribus alatis differt.

An annual *herb*; culms slender 7–40 cm. high; nodes 3–6, short at the base and increasing in length upwards, the uppermost often much exerted. *Leaves* erect, more or less densely beset with lax, spreading hairs from bulbous bases; sheaths closely embracing the culm, finely striate; blades linear, flat, sharply acute, nearly continuous with the sheaths, 2.5–7 cm. long, 2–5 mm. wide, midrib prominent below, continued into the sheath as a keel, lateral nerves 4, indistinct, margins revolute; ligules membranous, semicircular or shortly oblong, glabrous. *Racemes* 2-nate, divaricate, 0.7–2.7 cm. long; rhachis flat, 1 mm. wide, with a zig-zag blunt keel on the face, margins more or less densely ciliate; internodes less than half as long as the upper glume; pedicels short; callus short, white hairy. *Spikelets* 10–30, oblong-lanceolate, wider than the rhachis. Lower *glume* linear-oblong, acute or acuminate, 3–4 mm. long, margins hyaline, keel narrowly winged and ciliate; upper glume oblong-lanceolate, 3.4–4.2 cm. long, acuminate, margins hyaline and ciliate, keel broadly winged and ciliate, the wing rather corky. *Lemmas* hyaline; lower spathulate, 1.5–2.5 mm. long, sparsely ciliate;

upper 2.5-3.6 mm. long with a slender, geniculate awn 9-11 mm. long. *Anthers* 2, oblong, 1 mm. long.

S. Kanara District at Siradi, Nov., *A. Meebold* 10548 (type), 10752. "Abundant, predominant in places."

Ischaemum Rangacharianum C. E. C. Fischer, sp. nov. [Gramineae-Andropogoneae]; *I. semisagittato* Roxb. peraffine, sed foliis haud sagittatis, spicularum sessilium glumis inferioribus angustis nodulis marginalibus plus minus carinatis differt.

Perennial tufted *herb*. *Stem* erect or ascending from a prostrate, rooting base, 25-40 cm. high, leafy; nodes glabrous. *Leaf-sheaths* lax, ribbed, glabrous or more or less hairy along the margins and at the apex; ligules membranous, oblong, rounded, 1.5-4 mm. long, glabrous or pubescent; blades linear to linear-lanceolate, acuminate, base rounded or emarginate, sessile or petioled, 2-8.5 cm. long, 0.3-1 cm. wide, glabrous or more or less hairy on both faces, margins smooth or scaberulous; petioles 0-2.2 cm. long. *Peduncles* usually long-exserted, usually somewhat enlarged at the apex, glabrous. *Racemes* usually binate, rarely solitary, 2.5-7 cm. long; rhachis undulate; joints acutely trigonous in section or the outer angle blunt, enlarged to the 3-toothed apex, 3.7-4.8 mm. long, outer angle long hairy. *Spikelets* 2-nate, one sessile the other pedicelled; pedicels 1.8-2.5 mm. long, similar to the joints of the rhachis, separated from the lower glume by a groove. *Sessile spikelet*: *callus* turbinate, 1.2-2 mm. long, hairy below, separated from the glume by a groove; *lower glume* obliquely lanceolate, 4.6-6.5 mm. long, nearly flat, 2-keeled with narrowly inflexed nearly straight margins, basal portion stiffly chartaceous with 2-6 coriaceous, rather acutely ridged nodules on each margin, the back between smooth, apical part membranous, 5-7-nerved, the keels winged, wings broad on one side and narrow on the other, minutely ciliate, often purplish or reddish, the glume glabrous or minutely puberulous, sometimes with a few long hairs on the upper half; upper glume membranous, boat-shaped acuminate, strongly keeled, sometimes shortly cuspidate, 4.5-5.7 mm. long, minutely puberulous; *lemmas* hyaline, the lower narrowly lanceolate, acute, margins narrowly inflexed, its palea similar but with wider marginal flaps, containing two narrowly oblong to broadly obcuneate lodicules with truncate or lobulate apex and shortly produced outer angles and 3 stamens with linear anthers 3 mm. long; the upper lemma narrowly oblong or elliptic-lanceolate, 3.6-4.7 mm. long, 2-lobed for $\frac{1}{2}$ - $\frac{3}{4}$ of its length, lobes acute, with a geniculate awn from the sinus, awn 1-1.7 cm. long, the portion below the knee shorter, compressed, dark, smooth, the upper part pale-brown, compressed below and setaceous at the apex, minutely barbellate, the palea lanceolate with widely inflexed margins, containing 2 lodicules similar to those of the lower floret, 3 stamens and a pistil; grain ellipsoid, slightly compressed, 2 mm. long, smooth, brown. *Pedicelled spikelet*: *lower glume* narrowly lanceolate sometimes oblique, acute, flat, chartaceous, 2-keeled, 4.6-6.7 mm.

long, glabrous or sparsely hairy, one keel with a wide wing, sometimes toothed at the apex, the other very narrowly winged at the apex, margins narrowly inflexed, sometimes with 1-4 marginal nodules on one or both sides below the middle; *upper glume* similar to that of the sessile spikelet, 3.5-5.3 mm. long; *lemmas* hyaline, the lower similar in all respects to that of the sessile spikelet, the upper boat-shaped, acuminate and sometimes shortly aristate, keeled, margins with wide flaps at the apex and narrower below; 2.8-3.7 mm. long, the palea shorter, linear-lanceolate with inflexed margins, containing lodicules and a pistil and sometimes anthers as in the sessile spikelet.

Malabar District: Shoranur, Nov., *K. Ranga Achariyar* (type in Kew Herb.); Pudupadi, Nov., *K. Ranga Achariyar*; Melarkode, Dec., *Madras Herb.* 16356. Travancore: Courtallam, Dec., *M. Rama Rao's Collector* 2104; "Beyond Varkalay Bridge," Nov., *Madras Herb.*; "On the way from Kulathurpuzha to Rockwood Estate," *K. Venkoba* 4102, 4104; without precise locality, *V. Narayanaswami* 1743.

Fig. 130 of *Ischaemum aristatum* K. Ranga Achariyar non Linn. in K. Ranga Achariyar's "Handbook of Some South Indian Grasses" appears to have been drawn from the type sheet or that from Pudupadi.

***Ischaemum travancorense* Stapf MS.** sp. nov. [Gramineae-Andropogoneae]; *I. magno* Rendle affine, foliis glabris, petiolis tomentosis, lemmate superiore spicularum sessilium profunde 2-lobato differt.

A perennial herb. Culms subrobust, erect or ascending, up to 80 cm. high; nodes glabrous. *Leaf-sheaths* terete, smooth, the lower somewhat inflated and longer than the internodes, the upper close and shorter than the internode; ligules scarious, subacute or rounded, up to 4 mm. long; blades narrowly lanceolate, acute or acuminate, base rounded, often contracted into a very short tomentose petiole, margins spinulose-scabrid, otherwise glabrous. *Racemes* terminal, spiciform, 2-nate; peduncles shortly or considerably exserted, rigid, erect; rhachis slightly undulate; joints stout, obtusely trigonous in section, 3-6 mm. long, hollow, glabrous or sparsely ciliate on the back; pedicels 2.5-3 mm. long, similar to the joints, sometimes curved. *Sessile spikelet*: *callus* semi-annular, confluent with the bases of the joint and pedicel, 0.5-0.7 mm. long, glabrous or sparsely hairy; *lower glume* oblong, acute, 4.5-6 mm. long, 2 mm. wide, the basal $\frac{2}{3}$ coriaceous with 2-6 marginal nodules on either side, the disc between smooth or shallowly transversely rugose, the apical $\frac{1}{3}$ chartaceous, darker, 2-keeled with narrowly inflexed margins, often one or both keels narrowly winged; *upper glume* boat-shaped, acute, acutely-keeled, as long as the lower glume; *lemmas* hyaline, the lower lanceolate, acute, with narrowly inflexed margins, 4-5 mm. long, containing 3 stamens with linear anthers 3 mm. long, the upper narrowly oblong, 3.5-4.5 mm. long,

acutely 2-lobed for about half its length, with a geniculate awn up to 1 cm. long from the sinus, sometimes the awn not exceeding the lobes or even absent, the palea linear-oblong with widely inflexed margins, containing 3 stamens and a pistil. *Pedicelled spikelet*: *lower glume* oblong-lanceolate, often oblique, acute, 4-7 mm. long, 3 mm. wide, subcoriaceous, pale, smooth or rugulose towards the base, 2-keeled with narrowly inflexed margins, the exterior keel with a broad wing, the other narrowly winged; *upper glume* and *lower lemma* similar to those of the sessile spikelet; *upper lemma* hyaline, lanceolate, acute, entire, margins inflexed, 3.5-5 mm. long, its palea linear-lanceolate with widely inflexed margins, containing 3 stamens and a pistil.

Travancore: Alleppy in backwaters, Dec., *M. A. Lawson* 130 (type in Kew Herb.); Kumaragam near Kottayam, aquatic, *K. Venkoba Rao* 4070. Wynaad: Mudumallai, without number or collector's name (probably a *Beddome* specimen), in Kew Herb.

Ischaemum corollatum *Nees* ap *Steud. Synops.* 369, has been placed among the "doubtful species" by both *Hackel* (*Monogr. Phan.* 6, 252) and *Hooker* (*Fl. Brit. Ind.* 7, 139). Having seen the type sheet (*Royle* 264) I find that it is identical with *Phacelurus speciosus* (*Nees*) *C. E. Hubbard* (= *Andropogon speciosus* *Nees* ap *Steud Synops.* 1, 375), the type of which (*Royle* 263) is also in the Berlin Herbarium. In the first-named specimen the pseudospike is solitary and in the latter there are four.

Rottboellia divergens *Hack.* was described in *De Candolle's Monogr. Phanerog.* 6, 292 from a plant collected by *Huegel*, which is now in the Royal Museum at Vienna. The locality of collection is cited as "Asia (versimiliter India or.)."

Lisboa in the *Journ. Bomb. Nat. Hist. Soc.* 6, 195 (1891), referred a plant collected by himself at Mahableshwar to this species, but expressed his doubts of the correctness of the determination. In the *Fl. Brit. Ind.* 7, 155 (1897), *Lisboa's* as well as some plants collected by *Ritchie* are referred to this species and the habitat is given as: "East Indies, *Huegel*. The Concan and Canara; *Belgaum, Ritchie*; Satara and Mahableshwar, *Lisboa*."

By the courtesy of the Director of the Vienna Museum I have been able to compare *Lisboa's* and *Ritchie's* plants and some further material collected by *Meebold* with the type specimen and find that none of them agrees with it. These specimens, therefore, represent a distinct species.

R. divergens is described as having the lower glume of the sessile spikelet "cancellato-foveolata" on the back. These pits are due to the crossing of deep longitudinal grooves by very narrow transverse laminae or lines of papillae. The specimens quoted above are distinguished by the corresponding glumes being furnished with hooked spinules and long awns.

As shown by O. Kuntze, the section of the genus *Rottboellia* to which the species in question belongs should be segregated under the generic name *Manisuris* Linn. f.

As Lisboa's, Ritchie's and Meebold's plants are not *M. divergens* (Hack.) O. Ktze., a new specific name must be provided for them, and I propose *forficulata* in view of the resemblance of the lower glume of the sessile spikelet to a pair of shears.



Fig. 5. *Manisuris divergens* (Hack.) O. Ktze.
Lower glume of sessile spikelet. $\times 4$.

Since the closely allied species *M. acuminata* (Hack.) O. Ktze. and *M. Talboti* (Hook. f.) both come from the Bombay Ghats and coast, it is probable that Huegel collected his specimen in the hills East of Bombay on his way to the Himalayas.

As the material of *M. forficulata* previously available was scanty, an amplified description based on all the material seen by me is appended.

Manisuris forficulata C. E. C. Fischer, nom. nov. [Gramineae-Andropogoneae]; *M. divergens* (Hack.) O. Ktze. affinis, sed spicularum sessilium glumis inferioribus marginibus spinulosis differt.

Annual herb. Culms tufted, very slender, 6.25 cm. high, terete, slightly enlarged below the racemes, glabrous or more usually softly subappressed-hairy; nodes 2-3, glabrous, marked by a dark-coloured (when dry) constriction. Leaves basal and cauline, hirsute with fine hairs from minute tubercles; sheaths lax, compressed, striate; ligules membranous, rounded, short, glabrous or ciliate; blades narrowly linear, conduplicate or flat, finely acuminate, 4-12 cm. long, 1-5 mm. wide. Racemes terminal, solitary, spiciform, 2-6 cm. long; joints of the rhachis 2.5-3.3 mm. long, subclavate usually glabrous, sometimes minutely puberulous, especially on the margins, the apex truncate or slightly emarginate, the outer angle, at least, ciliate or with a tuft of long hairs, disarticulating and falling off together with both spikelets. Spikelets appressed to the rhachis, straw-coloured or pale-brown, the upper part and awns sometimes purple-tinted. Sessile spikelet with a very short transversely oblong or subrhomboid, glabrous callus; lower glume coriaceous, lanceolate or oblong-lanceolate, acute, 2.6-3 mm. long (excluding the awns), terminating in two diverging, ascendingly barbellate, often unequal, awns 5.5-6.7 mm. long, glabrous or minutely puberulous, the lower

$\frac{1}{2}$ – $\frac{2}{3}$ of the back convex, 4–5-nerved and usually 4–6, grooved, with 5–9 marginal spinules often as long as the glume is wide, with ciliate tips bent forwards at nearly right angles, the disk smooth or with a few similar spinules in the middle or the marginal spinules connected by regular rows of spinules, sometimes, again, the spinules fused together into continuous or discontinuous crenelated and ciliate laminae, the upper portion of the back flat with narrowly inflexed, winged margins, the wings membranous, more or less crescent shaped and continued onto the basal part of the awns, their margins minutely ciliate; *upper glume* chartaceous or membranous, lanceolate or elliptic-lanceolate, acuminate, convex, 2.5–3.2 mm. long, glabrous or minutely puberulous, margins inflexed; *lemmas* hyaline, lanceolate, margins ciliate, the paleae shorter, the lower lemma 2.5–3 mm. long, empty, the upper 2.2–2.5 mm. long, containing a bisexual flower; *lodicules* minute; *stamens* 3, anthers linear; 0.8 mm. long; *grain* ellipsoid, compressed, brown, smooth, 1.3–1.6 mm. long, embryo $\frac{1}{2}$ – $\frac{2}{3}$ as long. *Pedicelled spikelet* with a *pedicel* similar to and completely fused with the joint of the rhachis, as long or rather shorter, apex not ciliate; *glumes* chartaceous or subcoriaceous, glabrous or puberulous, the lower lanceolate to ovate, acute, convex, 2.4–3.5 mm. long with a terminal, ascendingly barbellate awn 6.8–10.7 mm. long, 5–9-nerved, one margin broadly winged, occasionally wingless, the wing continued onto the lower part of the awn, its margin ciliate; the *upper glume* boat-shaped, acute, 2.4–3.2 mm. long, terminated by a slender, often curved arista, 2.5–4.5 mm. long, the keel winged above, wing oblong, continued onto the lower half of the arista or higher, its margin entire, truncate, rounded or with two large teeth at the apex, ciliate; *lemmas* sometimes absent, if present hyaline, paleate or not, empty.



Fig. 6. *Manisuris forficulata* C. E. C. Fischer (nos. 2–5), and *M. forficulata* var. *hirsuta* C. E. C. Fischer (no. 6). Lower glumes of sessile spikelets. $\times 4$.

Bombay Presidency, Mahableshwar, Sept., *Dr. J. C. Lisboa*, without number (type in Kew Herb.); Belgaum, *Dr. Ritchie* 808, 827; Khandala, Sept., *A. Meebold* 8850, "on sheet rock"; N. Kanara at Castle Rock, Oct., *A. Meebold* 10558; Belgaum District,

Amboli Ghat, Oct., *W. A. Talbot* 4305. Cochin State at Kavalay, 3000-4000 ft., Nov., *A. Meebold* 13331.

var. **hirsuta** *C. E. C. Fischer*, var. nov.; a typo nodis, pedicellis glumis inferioribus generaliter dense hirsutis, spicularum sessilium glumarum inferiorum spinulis minoribus plus minusve indumento celatis, aristis curtioribus interdum glumis minoribus, spicularum pedicellatarum glumis superioribus cuspidatis, haud aristatis, ala cuspis apicem superante differt.

S. India: Bababudan Hills at Kalhatti, 6000 ft., Nov., *A. Meebold* 10559.

XLII—RESEARCHES ON *SILENE MARITIMA* AND *S. VULGARIS**†: XI. E. M. MARSDEN-JONES AND W. B. TURRILL.

GENETICS OF PETAL SIZE AND OF OTHER CHARACTERS IN *S. MARITIMA*.

The experiments recorded in this paper were carried out in order to investigate the genetics of petal size. All the material was of known wild origin and the parental stock-plants are fully described in the third paper of this series (*Kew Bull.* No. 5, 1929). The stock-plant 13, which is the most important subject of the experiments here considered, is unique in our collections in having very poorly developed petals which scarcely project beyond the calyx. The corolla is thus markedly contrasted with ordinary *S. maritima* corollas as exemplified in stock-plants 2 and 5.

Selfings.

N. 14. S.-P. 5 was selfed and produced a generation of 40 plants. The generation was uniform and like the parent in habit, leaves, inflorescence, calyx, corona, presence of anthocyanin blotch, filaments, stigmata, immature seeds, and capsules. All plants produced fully developed petals and hermaphrodite flowers.

N. 16. S.-P. 13 was selfed and produced a generation of 59 plants. The generation was uniform and like the parent in habit, leaves, inflorescence, calyx, corona, absence of blotch, anthers, filaments, stigmata, and immature seeds. All plants produced poorly developed petals. One plant had some flowers with normal sized petals in addition to flowers with poorly developed petals.

*Continued from *K.B.* 1932, 394.

† As a footnote to the first paper of this series (*Kew Bull.* 1928, 1) we pointed out that we agreed with the arguments, as at that time presented, of our colleague, Dr. T. A. Sprague, in favour of the name *Silene vulgaris* (Moench) Garcke for the common bladder campion. In a paper published in *Kew Bull.*, 1933, 151, evidence has now (i.e. since the Cambridge International Botanical Congress) been advanced in favour of the name *S. cucubalus* Wibel. As, however, it seems undesirable to change a name in the middle of a series of papers which are being published under one general title, we have decided to retain the name *S. vulgaris*. If *S. maritima* and *S. vulgaris* are combined in one species, as is done by some authors, the former name is apparently the correct one for the composite species.

Two plants deserve special mention. One plant had some open flowers with petals somewhat larger than the poorly developed petals of other plants of the generation and, in addition, flowers most of which failed to open, the calyx teeth remaining connivent and the flowers sterile, though in a few of these the stigmata projected. The second plant was still more extreme, most of the flowers remaining with enclosed petals and stamens but with protruding stigmata.

Crossings.

The following crossings were made:

N. 34. S.-P. 5 $\times$ S.-P. 13 (F_1).

N. 69. N. 34, Plant 26 selfed (F_2).

N. 36. S.-P. 2 $\times$ S.-P. 13 (F_1).

N. 68. N. 36, Plant 1 selfed (F_2).

N. 34. 50 plants in generation.

Habit uniform and as S.-P. 5; stems up to 3.5 dm. long, with some anthocyanin.

Leaves intermediate between those of the parents for shape and colour.

Inflorescence with from 3 to 7 flowers, erect and actinomorphic.

Calyx with much anthocyanin, narrow-cylindric.

Corolla with full-sized petals, petals and segments not overlapping, $\frac{3}{4}$ lobed, bilobed. In 34 plants blotch present, in 16 plants blotch absent. In 41 plants full-sized scale, in 8 plants small scale, in 1 plant boss.

Androecium: all plants with purple anthers and pink filaments and all had hermaphrodite flowers.

Gynaecium of all flowers with stigmata pink and immature seeds pink.

Seeds of all plants armadillo.

Plant 26 had the following characters: blotch present and full sized scale.

N. 69. 25 plants in generation.

Habit of all plants prostrate; stems up to 3.2 dm. long, with much anthocyanin.

Leaves of 16 plants narrow as in S.-P. 5, of 9 plants intermediate as in immediate parent; 23 with some anthocyanin, 2 with much anthocyanin.

Inflorescence with from 1 to 5 flowers, erect and actinomorphic.

Calyx with much anthocyanin; of 9 plants narrow-ellipsoid, of 16 plants, narrow-cylindric.

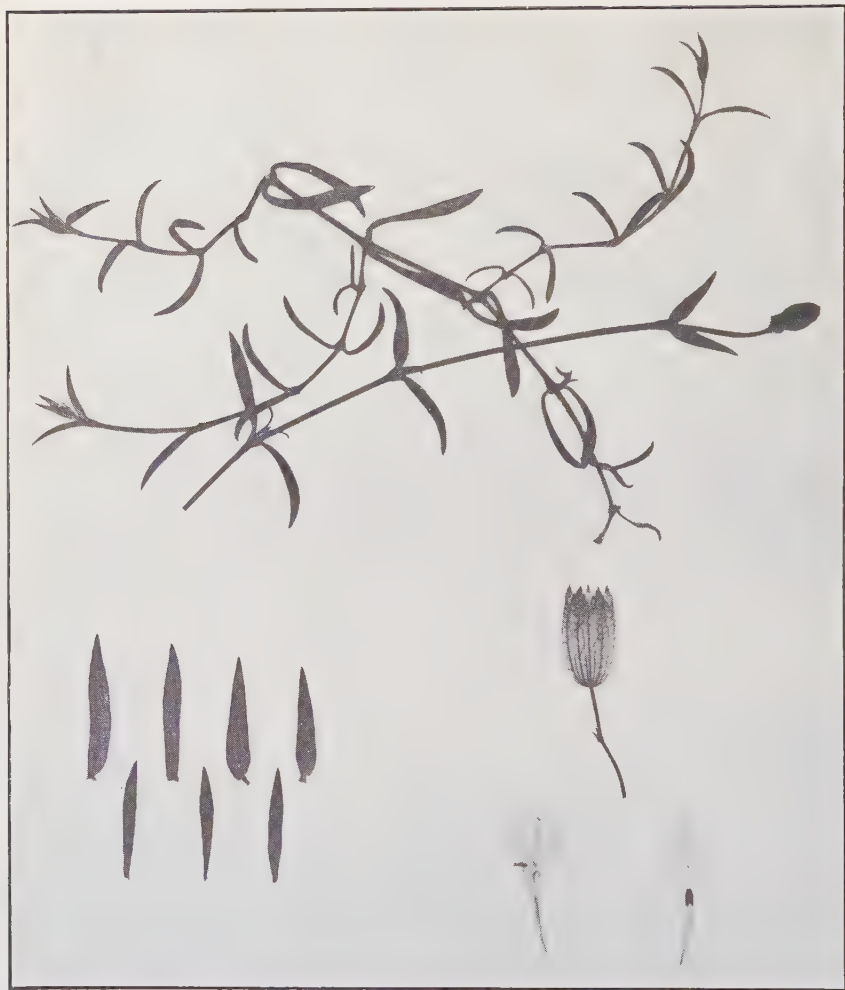
Corolla: in 17 plants petals full-sized, in 8 poorly developed; in 5 plants petals overlapping, in 20 plants petals not overlapping; in 4 plants segments overlapping, in 21 plants not overlapping; in all plants $\frac{3}{4}$ lobed; in all plants bilobed; in 16 plants blotch present, in 9 plants blotch absent; in 14 plants good scale, in 9 plants small scale, in 1 plant boss to very small scale, in 1 plant boss.

PLATE XIV



Silene maritima, stock-plant A2, Tilly Whin, Swanage, 1923.

PLATE XV



Silene maritima, stock-plant A5, Chesil Beach, Portland end, 1926.

Androecium : all plants had hermaphrodite flowers ; in 21 (or 20) plants filaments pink, in 4 (or 5) plants filaments white ; in all plants anthers purple.

Gynaeceum : in 21 plants stigmata pink, in 4 plants white ; immature seeds of all plants pink.

Seeds of all plants armadillo.

N. 36. 44 plants in generation.

Habit as in parents, stems up to 3.2 dm. long, with a trace of anthocyanin.

Leaves as in parents.

Inflorescence with from 3 to 7 flowers, erect and actinomorphic.

Calyx with much anthocyanin ; shape ranged from narrow-cylindric to broadly ellipsoid and showed considerable variation even on one plant.

Corolla with full-sized petals, petals and segments overlapping in 43 plants, petals overlapping and segments not overlapping in 1 plant, all $\frac{3}{4}$ lobed and bilobed. In 12 plants blotch present, in 32 plants blotch absent. In all plants good scale.

Androecium : 26 plants with only hermaphrodite flowers ; 7 plants with only female flowers ; 11 plants with both hermaphrodite and female flowers. All plants with anthers had these purple. 19 plants had pink filaments ; 18 plants had white filaments.

Gynaeceum : of 29 plants stigmata pink ; of 15 plants stigmata white. All plants had pink immature seeds.

Seeds of all plants armadillo.

Plant 1 had the following characters : calyx narrow-ellipsoid ; petals and segments overlapping, blotch present ; hermaphrodite ; filaments white ; stigmata white.

N. 68. 59 plants in generation.

Habit uniform and as immediate parent ; stems up to 3 dm. long, with a trace of anthocyanin.

Leaves as in immediate parent.

Inflorescence as in immediate parent.

Calyx : in 48 plants as in immediate parent, in 11 plants narrow-cylindric.

Corolla : in 46 plants petals full-sized, in 13 poorly developed ; in 23 plants petals overlapping, in 36 plants petals not overlapping ; in 20 segments overlapping, in 39 segments not overlapping ; in 45 plants $\frac{3}{4}$ lobed, in 14 plants $\frac{2}{3}$ lobed ; in 13 plants multilobed, in 46 bilobed ; in 21 blotch present, in 38 blotch absent ; in 57 good scale, in 2 small scale.

Androecium : 37 plants had only hermaphrodite flowers, 10 had female flowers only, and 12 some flowers hermaphrodite some female ; all plants with stamens had white filaments and purple anthers.

Gynaeceum of all flowers with white stigmata and pink seeds.

Seeds of all plants armadillo.

Conclusions.

Petal development.

S.-P. 13 had poorly developed petals and bred true for this character. S.-P. 2 and S.-P. 5 bred true for fully developed petals. In the crosses N.34 and N.36, S.-P. 13 was used as the pollen parent on S.-P. 5 and S.-P. 2 respectively, each of which had fully developed petals. Both F_1 generations had full-sized petals. In F_2 the following ratios were obtained :

N. 69, 17	full-sized :	8	poorly developed petals.
N. 68, 46	„	13	„ „ „ „
Totals 63	„	21	„ „ „ „

We suggest that these figures represent a monohybrid 3 to 1 ratio.

Habit.

All the plants had the prostrate habit of *S. maritima*.

Leaves.

S.-P. 13 and S.-P. 5 bred true for their respective leaf-shapes. Their F_1 was intermediate, but only the narrow (S.-P. 5) and intermediate (F_1) shapes reappeared in F_2 in the ratio 16 : 9. We know from many crosses that narrowness of leaf is a very prepotent factor in *Silene* crosses. In N. 36 and N. 68 the leaf-character remained as in the original parents.

Calyx.

S.-P. 13 and S.-P. 5 bred true for their respective shapes, F_1 gave all narrow-cylindric (as S.-P. 5), F_2 gave narrow-cylindric : narrow-ellipsoid :: 16 : 9. In N. 36 the calyx shapes proved scarcely scorable, in the F_2 the plants were scored as 48 narrow-ellipsoid : 11 narrow-cylindric.

Corona.

All parents had scales, but these were poorly developed in S.-P. 13. In N. 34 the ratio obtained was 41 scale : 8 small scale : 1 boss, and in N.69 (from selfing a plant with a scale) 14 scale : 10 (9) small scale : 1 (2) boss. In N. 36 all plants had scales but in N. 68 the ratio was 57 scale : 2 small scale ; of the 57 with at least fairly well-developed scales 7 had particularly well-developed scales. The factor for poorly developed petals undoubtedly influences scale development, though in a manner not statistically determined, and is, at least partly, responsible for the above ratios.

Lobing of petals.

Multilobing appeared only in N. 68 (an F_2 generation), in the ratio 13 multilobed : 46 bilobed. Consideration of the genetics of lobing is reserved for a future paper in this series.

Depth of petal lobing.

S.-P. 13, its selfed offspring S.-P. 5, and the F_1 (N. 34) had $\frac{3}{4}$ lobing as had all plants of the F_2 (N. 69). S.-P. 2 and the F_1 (N. 36) had also $\frac{3}{4}$ lobing, and S.-P. 2 was homozygous for this character (see *Kew Bull.* 1928, 12), but the F_2 (N. 68) gave 45 with $\frac{3}{4}$: 14 with $\frac{2}{3}$. There is a high correlation in N. 68 between poorly

PLATE XVI



Silene maritima, stock-plant A13, Chesil Beach, eastern portion, near the roadside, 1926.

developed petals and $\frac{2}{3}$ lobing, 11 of the plants with $\frac{2}{3}$ lobing having poorly developed petals. Some factor influence brought in from S.-P. 2, presumably in a heterozygous condition, appears to be responsible for the F_2 (N. 68) ratio.

Blotch on petals.

S.-P. 13 and its selfed offspring had no blotch, S.-P. 5 had a blotch. The F_1 (N. 34) gave 34 blotch : 16 no blotch. The immediate parent of F_2 (Plant 26 of F_1) had a blotch and on selfing gave 16 blotch : 9 no blotch.

In N. 36 the ratio was 12 blotch : 32 no blotch and the immediate parent of the F_2 (Plant 1 of N. 36) had a blotch and on selfing gave 21 blotch : 38 no blotch. We did not score S.-P. 2 for blotch but assume that it had a blotch and was heterozygous for blotch—no blotch. The plant is now dead. The F_2 ratios are reversed—16 : 9 and 21 : 38. These results may be compared with those obtained for anthocyanin development in other organs (see *Kew Bull.* 1932, 236–238).

Overlapping of petals and segments.

In S.-P. 13 and its selfed offspring, and in F_1 (N. 34) petals and segments did not overlap. S.-P. 5 had not overlapping petals but contiguous segments. In F_2 (N. 69) the results were :

petals overlapping 5 : not overlapping 20.

segments „ 4 : „ „ 21

S.-P. 2 had petals and segments contiguous. In F_1 (N. 36) all plants had overlapping petals and all except one overlapping segments. In F_2 (N. 68) the results were :

petals overlapping 23 : petals not overlapping 36

segments „ 20 : segments „ „ 39

Absence of overlapping is here largely due to the influence of the poorly developed petal character, since, owing to the small size of the petal lamina, neither petals nor segments can normally overlap in a flower with poorly developed petals. At the same time there are other independent factors controlling overlapping or not overlapping of petals and segments.

Androecium.

All three stock plants, the selfed generation, and both F_1 and F_2 generations had purple anthers. S.-P. 13 and the selfed generation had white filaments. S.-P. 5, its selfed generation, and the F_1 (N. 34) had pink filaments. The F_2 (S.-P. 69) showed segregation in the ratio 21 (20) pink : 4 (5) white. S.-P. 2 had pink filaments and the F_1 (N. 36) segregated in the ratio 19 pink : 18 white. The immediate parent of the F_2 and the whole F_2 generation had white filaments. It is evident that pink is dominant to white, this latter being a pure recessive. Stock plants 13 and 5 were homozygous for white and pink respectively and S.-P. 2 heterozygous. The F_2 ratio of N. 69 is 5 : 1 ; the F_1 ratio of N. 56 is 1 : 1.

S.-P. 13 and S.-P. 5 were fully hermaphrodite. S.-P. 2 was mainly female, but various flowers contained from 1 to 10 stamens

(see *Kew Bull.* 1928, pp. 4-6). The selfing of S.-P. 13, the F_1 of this with S.-P. 5 and the F_2 had all hermaphrodite flowers. In the F_1 and F_2 (from a ♂) of S.-P. 13 with S.-P. 2 (N. 36) the ratios were:

F_1 26 ♂ : 7 ♀ : 11 ♂ and ♀

F_2 37 ♂ : 10 ♀ : 12 ♂ and ♀

The occurrence of purely female plants, approximately in 5 : 1 ratios, is undoubtedly due to the influence of S.-P. 2.

Gynaeceum.

S.-P. 13 and its selfed generation had white stigmata. S.-P. 5, its selfed generation, and the F_1 (N. 34) plants all had pink stigmata. The F_2 generation (N. 69) segregated in the ratio 21 pink : 4 white. S.-P. 2 had pink stigmata and the F_1 (N. 36) segregated in the ratio 29 pink : 15 white. The immediate parent of the F_2 generation (Plant 1) and all plants of the F_2 had white stigmata. It is evident that pink is dominant to white, this latter being a pure recessive. Stock-plants 13 and 5 were homozygous for white and pink respectively and S.-P. 2 heterozygous. The F_2 ratio of N. 69 is 5 : 1; the F_1 ratio of N. 36 is 2 : 1.

In all stock-plants, in all plants of the selfed, F_1 , and F_2 generations the immature seeds were pink.

Seeds. In all stock-plants, in all plants of the selfed, F_1 , and F_2 generations the mature seeds were armadillo.

Summary.

1. An account is given of selfing a plant with poorly developed petals and of crossing it with each of two other stock-plants having normal petals. The character pair shows a monohybrid genetic basis in its inheritance, segregating in F_2 in a ratio of 3 fully developed : 1 poorly developed petals.

2. Scorings were made of habit, leaf shape, calyx shape, corona development, lobing of petals, depth of petal lobing, presence or absence of blotch on petals, overlapping of petals and segments, colour of anthers, filaments, stigmata, and immature seeds, sex, and testa patterns of mature seeds. The figures obtained for these characters are discussed.

The research on which this paper is based has been aided by a Royal Society Government grant.

XLIII—THE DATES OF HOOKER'S "COMPANION TO THE BOTANICAL MAGAZINE." T. A. SPRAGUE.

The work consists of two volumes bearing the dates 1835 and 1836 respectively on their title pages. Actually it was issued in 24 monthly parts from Aug. 1835 to July 1837, together with the corresponding numbers of Curtis's Botanical Magazine. This information and the dates of publication given below have been obtained from the advertisements on an incomplete set of Botanical Magazine wrappers in the Library of the Kew Herbarium. On the last page of the wrapper for July 1, 1835, there is an advertisement of

the Companion to the Botanical Magazine, stating that the first number will be issued with the August number of the Botanical Magazine. On the wrapper for Aug. 1, 1835, it is stated that "the first Number [of the Companion] appears with the present Number of the Botanical Magazine." Similarly we learn that the second number appeared on Sept 1, 1835, the sixth on Jan. 1, 1836, the eighth on March 1, 1836,* and the twenty-fourth number on July 1, 1837, after which the work was discontinued.

It is stated in the advertisement of the "Companion" that "A Number, consisting of two sheets of closely printed pages, accompanied by two plates, partially coloured, will appear every month, price 1s. 6d.; or if taken stitched with the Magazine, only 1s." By a curious mistake each volume was estimated to consist of nearly 450 pages instead of nearly 400 (384), and this miscalculation was repeated in each advertisement of the work.

Actually, only nineteen plates were issued with the first twelve numbers, instead of the twenty-four promised, but four of them (III, VIII, XI, XVI), were double plates, the total being equivalent to twenty-three single plates. In the second volume there were only thirteen plates, six (XXII, XXIII, XXIV, XXVI, XXVIII, XXX), being double ones. Adding three portraits, the total is equivalent to twenty-two single plates. Owing to these discrepancies it has not been possible to ascertain with certainty the actual numbers in which the several plates appeared. Assuming, however, that a double plate was regarded as the equivalent of two single ones, that no more than two single plates or one double one was included in any number, that as far as possible, subject to the preceding conditions, the plates accompanied the letterpress to which they referred, and that the title page and index issued with number 12 were regarded as the equivalent of one plate, the plates may have appeared as indicated below.

COMPANION TO THE BOTANICAL MAGAZINE, VOL. I.

- No. 1, pp. 1-32 [tt. I, II]—Aug. 1, 1835.
- No. 2, pp. 33-64 [t. III]—Sept. 1, 1835.
- No. 3, pp. 65-96 [tt. IV, V]—Oct. 1, 1835.
- No. 4, pp. 97-128 [tt. VI, VII]—Nov. 1, 1835.
- No. 5, pp. 129-160 [t. VIII]—Dec. 1, 1835.
- No. 6, pp. 161-192 [tt. IX, X]—Jan. 1, 1836.
- No. 7, pp. 193-224 [t. XI]—Febr. 1, 1836.
- No. 8, pp. 225-256 [tt. XII, XIII]—March 1, 1836.
- No. 9, pp. 257-288 [tt. XIV, XV]—April 1, 1836.
- No. 10, pp. 289-320 [t. XVI]—May 1, 1836.
- No. 11, pp. 321-352 [tt. XVII, XVIII]—June 1, 1836.
- No. 12, pp. 353-384 [t. XIX]—July 1, 1836.

COMPANION TO THE BOTANICAL MAGAZINE, VOL. II.

- No. 13, pp. 1-32 [tt. XX, XXI]—Aug. 1, 1836.
- No. 14, pp. 33-64 [t. XXII]—Sept. 1, 1836.
- No. 15, pp. 65-96 [t. XXIII]—Oct. 1, 1836.
- No. 16, pp. 97-128 [portrait of David Douglas]—Nov. 1, 1836.

* By an oversight this advertisement was repeated verbatim on May 1, 1836, with the word "eighth" instead of "tenth."

- No. 17, pp. 129-160 [t. XXIV]—Dec. 1, 1836.
 No. 18, pp. 161-192 [t. XXV]—Jan. 1, 1837.
 No. 19, pp. 193-224 [t. XXVI]—Febr. 1, 1837.
 No. 20, pp. 225-256 [t. XXVII, and portrait of Richard Cunningham]
 —March 1, 1837.
 No. 21, pp. 257-288 [t. XXVIII]—April 1, 1837.
 No. 22, pp. 289-320 [portrait of John Fraser, and t. XXIX]—May 1,
 1837.
 No. 23, pp. 321-352 [t. XXX]—June 1, 1837.
 No. 24, pp. 353-381 [tt. XXXI, XXXII]—July 1, 1837.

Since the dates of publication of the several parts of the text are known with certainty, while those of the plates are conjectural, only the former can be taken into account for the purposes of priority. Even if the tentative allocation of plates given above were proved to be correct by inspection of a set of the "Companion" in its original wrappers, no nomenclatural changes would be involved thereby, since the plates which seem to have been issued before the corresponding text are in all cases those of old species.

It has seemed worth while to investigate the dates of Hooker's Companion to the Botanical Magazine in view of the considerable number of important taxonomic papers which it contains. Among these are Hooker and Arnott's Contributions towards a flora of South America, Hooker's Contributions towards a flora of Van Diemen's Land, Wight and Arnott's Illustrations of Indian Botany, William Jack's Description of Malayan Plants, Bentham's Synopses of the Gerardiaceae, Buchneraceae and Hemimerideae, and Observations on some new or little known genera and species of Scrophulariaceae, and Lindley's Notes on Drège's Cape Orchidaceae.

XLIV—CONTRIBUTIONS TO THE FLORA OF BURMA : XI.* C. E. C. FISCHER.

Mucuna sempervirens Hemsl. [Papilionaceae].

Known from W. China.

Bhamo District, Sinlum Kaba, 5500 ft., fls. greenish-white, April, *J. H. Lace* ; Maymyo plateau, 3500 ft., frt. June, *J. H. Lace* 5811 and fls. March, *J. H. Lace* 6118.

Hoeckia Aschersoniana Engl. et Graebn. [Valerianaceae].

Previously known from China.

Burma-Tibet frontier, near source of Irawaddy, 28° 30' N. 97° 45' E., 12,000-14,000 ft., *Kingdon Ward*, grown at Kew from roots. "Forming matted growth with other herbaceous and woody plants."

Ophiorrhiza umbricola W. W. Smith. [Rubiaceae].

Previously reported from N. Burma (*Kingdon Ward*) as well as from China, but the present extends the range far to the south.

Amherst District, Mulayit Peak, 6200 ft., fls. Feb., *C. E. Parkinson* 5156 ; Bhamo District, Naru Bum, in evergreen forest at 7400 ft., fls. March, *Maung Mya* per *C. E. Parkinson* 5328. "1-4 ft.

* Continued from *K.B.* 1932, 106.

high ; stem grey ; corolla white, stamens purple." In drying, the leaves and upper part of stems have turned purple and the corollas scarlet to purplish-red. Karen name ; *Ta-thee-khor*. The leaves in these specimens attain a larger size than that given in the description.

Craibiodendron Henryi *W. W. Smith*. [Ericaceae].

Known from Yunnan.

Bhamo District, Pangkok, Lakpyekha, 6500 ft., frt. March, *Maung Mya* per *C. E. Parkinson* 4985 ; Myitkyina District, Htawgaw, 5700 ft., fls. June, *Sukoe* per *C. E. Parkinson* 10096. "Middle-sized tree ; flowers white tinted red."

Palaquium Sukoei *C. E. C. Fischer*, sp. nov. [Sapotaceae] ; *P. paucivenoso* Lam. accedit, sed foliorum nervis primariis paucioribus, fructibus oblongis multo majoribus differt.

A tree. Leaves aggregated at the ends of the twigs, thinly coriaceous, obovate or obovate-oblong, apex obtuse, sometimes retuse, base cuneate, shortly decurrent, 6.5-12.5 cm. long, 3.5-6.3 cm. wide, glabrous above, minutely appressed-pubescent below, drying brown, paler below, midrib slightly impressed above, prominent below, primary nerves 8 pairs, raised below, anastomosing in wide loops well within the margins, ultimate reticulations fine ; petiole terete, 1-2.2 cm. long. Flowers axillary, fascicled, scented ; bracts deciduous, linear-lanceolate, 3 mm. long, pedicels sulcate when dry, slender in flower, very thick in fruit, 0.8-1.2 cm. long, fulvous-tomentose. Sepals 6, in 2 rows, 5-5.4 mm. long, fulvous-tomentose without, pubescent on the upper half within, the 3 outer thick, fleshy, valvate, ovate from a broad base, obtuse, the 3 inner thinner and slightly shorter, elliptic, apex rounded, with a median vertical channel on the back corresponding with a keel within. Corolla white, narrowly turbinate, glabrous except the tube which is shortly hairy within ; tube 2.5 mm. long ; lobes 6, ligulate, obtuse, 4.5 mm. long. Stamens 12, inserted on the mouth of the corolla-tube ; filaments subulate, 2.5 mm. long, patently white-villous ; anthers ovate, bluntly apiculate, 1.5-2 mm. long. Ovary oblate, 1.5 mm. high, 2 mm. diam., densely hairy, 6-celled, ovules solitary in each cell, pendulous, flat. Style cylindric, 8-8.5 mm. long, glabrous, apex minutely 6-lobed. Fruit oblong, 4.2 cm. long, reddish-brown, minutely scaly.

Tenasserim, Tharapon, 800 ft., fls. May, *Sukoe* per *C. E. Parkinson* 11091 (type in Kew Herb.) ; 400 ft., frt. Feb., *Sukoe* per *C. E. Parkinson* 10896. "Blaze purple or brick-red, exuding milky juice ; heartwood dark-red." Vern. name ; *Pyinlebyin*.

Styrax biaristatus *W. W. Smith*. [Styracaceae.]

Known from Yunnan.

Myitkyina District, Htawgaw, 3100 ft., fls. April, *Sukoe* per *C. E. Parkinson* 9197 ; Pyetpat Pass, 7200 ft., fls. June, *Sukoe* per *C. E. Parkinson* 10115. "Tree ; stem dark-grey ; fls. white."

Torenia vagans Roxb. [Scrophulariaceae].

Known from Nepal to Assam and in S. India.

Bhamo-Shan State boundary, 45 miles from Bhamo, at roadside near Hkalon Inspection Bungalow, 4000 ft., fls. and frt. Sept., *J. N. List*.

Nepeta lamiopsis Benth. [Labiatae].

Known from Sikkim Himalayas.

Burma-Tibet frontier, near source of Irawaddy, *Kingdon Ward*, grown from roots at Kew. "Forming matted growth with other plants."

Polygonum viviparum Linn. [Polygonaceae].

Known from Kashmir to Sikkim.

Locality and details as in the last species.

Pseudotreblus indica Bur. [Moraceae].

Known from Assam.

Myitkyina District: confluence of the Hpungin Kha and the Mali Kha, 700 ft., fls. and frt. June, *Saw Maung Mya* per *C. E. Parkinson* 5462, "Stem brownish-white; twigs hanging; fls. white, frt. green."

XLV—MISCELLANEOUS NOTES.

OTTO STAPF. We have to record with great regret the death on August 4th, at the age of 75, of Dr. Otto Stapf, F.R.S., Keeper of the Herbarium from 1909 to 1922, and subsequently editor of the *Botanical Magazine* and the *Index Londinensis*. An appreciation of Dr. Stapf and his work will appear in the next number of the *Bulletin*.

CLIVE ERROL LORD. We record with deep regret the death of Mr. Clive Lord, Director of the Tasmanian Museum and Art Gallery. Mr. Lord was in constant correspondence with Kew during the last five years, and by his death at the early age of 44 a career, valuable both to Tasmanian Science and as a link between that country and British Naturalists, has been cut short.

Mr. Lord was born and educated at Hobart and served for some years on the staff of the Tasmanian Museum before being appointed Curator in 1918 and Director in 1922. As Director he did much to encourage the study of the Natural History of the Island, and himself contributed many papers to scientific journals on various aspects of the subject, especially on the fauna and flora of the National Park area in the west of the Island. He was part author of "The Vertebrate Animals of Tasmania."

Mr. Lord was especially active in recent years in adding to and improving the Botanic Garden and Herbarium, which were visited by the Director of Kew in 1928.

W. G. CRAIB. We record with deep regret, as this number goes to press, the death at Kew, on Sept. 1st, of Prof. W. G. CRAIB, F.R.S.E., Regius Professor of Botany in the University of Aberdeen.

The Botanical Magazine.—Part 3 of Volume 156 was published on July 1st, 1933, and contains the following plant portraits, opening with a description of the new genus *Pamianthe*, with one species *P. peruviana* Stapf (t. 9315), raised by Major Albert Pam, after whom it is named: it is a fine white-flowered Amaryllidaceous plant allied to *Pancratium* and comes from Peru:—*Cercis racemosa* Oliver (t. 9316), an interesting "Judas-Tree" from central China, with flowers similar to those of the familiar European *Cercis siliquastrum*; *Sphenogyne versicolor* DC. (t. 9317), a charming annual from the north-western Cape Province and Little Namaqualand, South Africa, introduced to gardens early in the last century; *Kleinia radicans* DC. (t. 9318), the Klein-Bokkost (small goat's food) of the Karroo farmers, a native of the southern Karroo, South Africa; *Rhododendron pubescens* Balf. f. & Forrest (t. 9319), a beautiful pink, small-flowered shrub from southern Szechuan and northwestern Yunnan; *Ajuga grandiflora* Stapf (t. 9320), a new species allied to *A. australis* R. Br., from South Australia and New South Wales, which promises to be an interesting garden plant; *Tulipa tarda* Stapf (t. 9321), a new species nearly allied to *T. persica* Hort and *T. turkestanica* E. Regel—probably a native of Turkestan; *Hoya Kerrii* Craib (t. 9322), a species with obcordate leaves and revolute corollas, a native of northern Siam and French Indo-China; *Rhododendron nilagiricum* Zenker (t. 9323), a native of the Deccan Peninsula and Ceylon and the earliest Indian rhododendron on record, having first been seen in Ceylon in 1344; *Hydrangea strigosa* Rehder (t. 9324), a native of Hupeh, Szechuan and Yunnan and *Physosiphon Lindleyi* Rolfe (t. 9325), a native of the province of Chiapas, Mexico.

Flora Capensis.—This work has now been completed as originally planned and a supplementary volume, forming Section 2 of vol. 5, and containing the Welwitschiaceae, Podocarpaceae, Cupressaceae and Cycadaceae, was published on March 25th, 1933.

The Preface written by the Director, which is here reprinted, gives the history of the undertaking.

"When the *Flora Capensis* was originally planned, it was intended to include the *Gnetaceae*, *Coniferae*, and the *Cycadaceae*. The description of *Welwitschia* was prepared for the purpose several years ago by the late Professor H. H. W. Pearson, and the Conifers were described by Dr. O. Stapf, F.R.S., late Keeper of the Herbarium and Library. Sir William Thiselton-Dyer, the Editor of the later volumes of the *Flora Capensis*, had always intended to write the account of the South African *Cycadaceae* after his retirement, but failing health prevented him from carrying out the project, to which he had for many years devoted considerable study. Shortly before

his death he handed over to me the material he had collected together and his notes, expressing the wish that I should undertake the work. While in South Africa in 1930, I was able to discuss the matter with Dr. Rattray, who has made careful studies of the South African Cycads in the field, and has grown most of them in his garden. He very kindly agreed to collaborate with Mr. J. Hutchinson, F.L.S., in the preparation of the descriptions of the Cycads for this supplemental volume. While Mr. Hutchinson is mainly responsible for the technical descriptions, Dr. Rattray's intimate knowledge of the plants, as they grow in South Africa, has added very greatly to the value of the undertaking.

"The account of *Welwitschia* has been supplemented by Mr. Hutchinson to bring it up-to-date in the light of recent knowledge. It has been raised to family rank as distinct from *Gnetaceae* (*Gnetum* and *Ephreda*), with which it has probably little in common apart from the Gymnospermous character. Dr. Stapf has largely re-written his descriptions of the South African *Podocarpaceae* and *Cupressaceae*.

"The publication of this supplemental part of the *Flora Capensis* has been made possible by the generosity of the Government of the Union of South Africa, who on learning, through Kew, of the desire expressed by Botanists in South Africa for an account of the Gymnosperms, made a grant of £40 towards its publication.

"The history of the inception and completion of the *Flora Capensis* which deals with the flowering plants proper—*Angiospermae*—was published by Sir William Thiselton-Dyer in the *Kew Bulletin*, 1925, pp. 289–293, and his valedictory preface will be found in Vol. V, Sect. 2, Part IV, of the *Flora Capensis*, written on 23rd September, 1924.

"For the loan of herbarium material from South Africa we are much indebted to Dr. I. B. Pole Evans, C.M.G., Director of the Botanical Survey, to the Forestry Department in South Africa, and to the Directors of the Cape Town and Albany Museums."

The volume differs from the rest of the *Flora* in being provided with illustrations, which greatly add to the value of the work.

Among the Cycads, a new and interesting *Encephalartos*, *E. kosiensis* Hutch., is included. Full material of this has unfortunately not yet reached Kew, but we have since learnt that specimens in cultivation at Kirstenbosch and Durban are some 4 ft. or more in height and the cones are of a bright red colour.

One unfortunate printer's error was overlooked when reading the proofs relating to the recent discovery of a large area of *Welwitschia*. The locality where this was found is in the Kaoko-veld, S.W. Africa, and not "Kakao-veld" as printed.

It is hoped that this final volume will be of assistance to the botanists in S. Africa in dealing with their Conifers and Cycads.

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